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As one of its major activities in carrying out its purpose, the Society publishes a monthly magazine, the Canadian Geographical Journal, which is devoted to every phase of geography — historical, physical and economic — of Canada, of the British Commonwealth and of the other parts of the world. It is the intention to publish articles in this magazine that will be popular in

character, easily read, well illustrated, and informative.

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Canada's Atlantic Salmon

by F. H. WOODING

MANY thousands of years ago a great ice field covered much of what we call the northern hemisphere. Over the long ages, during successive advances and retreats, this colossal weight transformed vast portions of the earth's surface. Whole mountain ranges were shaped and re-shaped, plateaux and low-lands were altered again and again, and the waters of the land were moved to form new seas and lakes and rivers. Then at last the ice sheet again retreated, leaving the hemisphere much as we know it today.

During that time, the creatures of the seas experienced remarkable environmental changes.

Many fishes that were once inhabitants of salt water found themselves in freshwater areas, some of them without access to the sea; others were moved from one side of the world to the other. Thus it was with the most interesting family of them all — the Salmonidae: the salmon, trout, and char.

Scientists believe that the Salmonidae were once migratory fish of the Arctic and that great movements of the ice fields took them out of their original habitat and left them scattered throughout Europe, Asia and North America. To give weight to this theory is the fact that, aside from human transplantation of some

CANADA'S ATLANTIC SALMON

stocks to certain countries below the equator, species of the Salmonidae family are found only in the northern hemisphere.

At one time, it is thought, the Pacific side of the Arctic was the exclusive home of the salmon; but as geological changes took place one member of the family found itself in a new environment — the Atlantic ocean. This salmon — which became known as the Atlantic salmon — flourished in its new abode. Not all of the genus was moved, for the Steelhead fishes of the Pacific, including the sea-run Steelhead and its brother, the Kamloops trout (which spends all of its time in fresh water) are so similar in make-up and characteristics that they are considered by some scientists as being blood brothers of the Atlantic salmon.

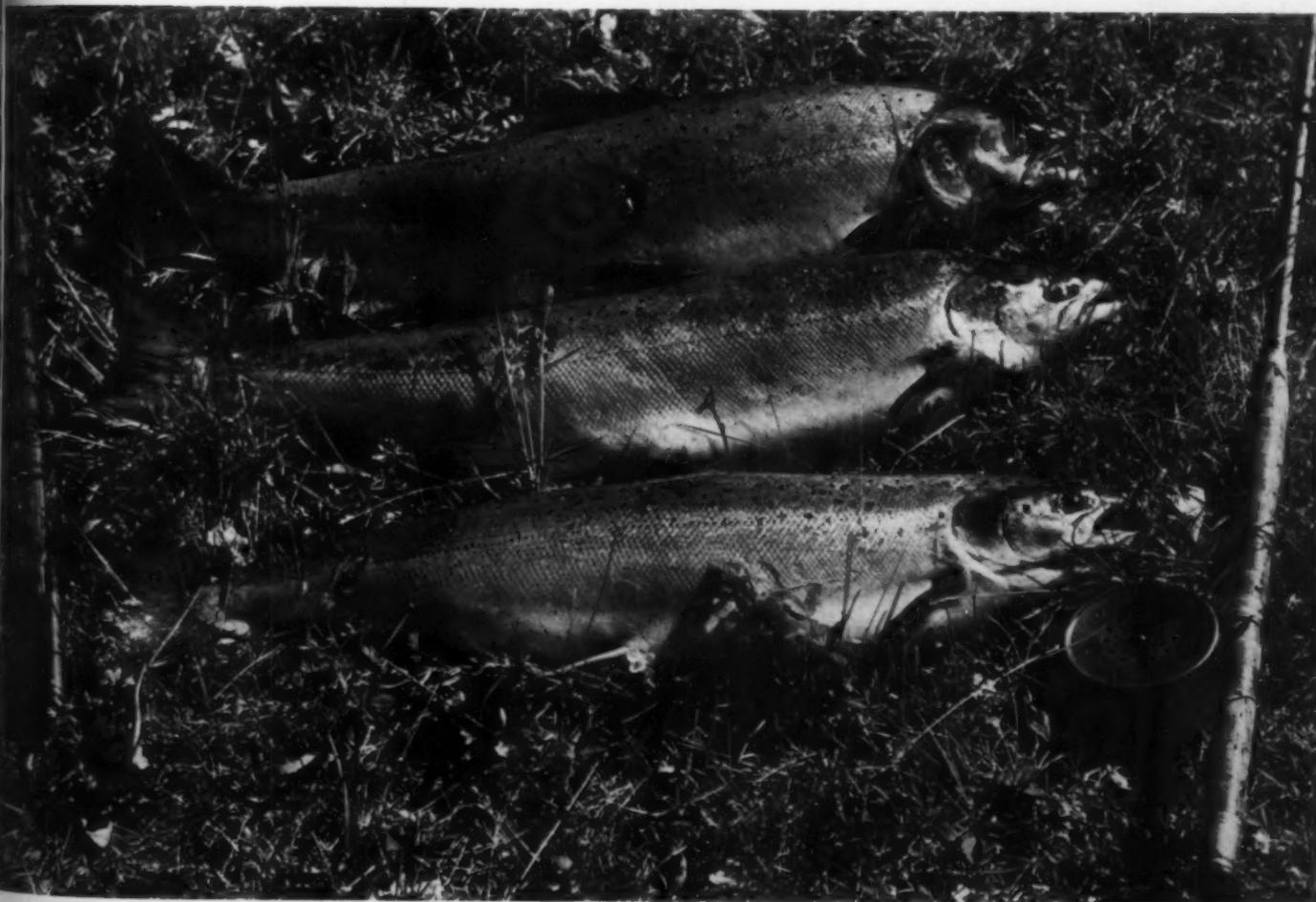
In any event, the Atlantic salmon prospered not only in numbers but in fame as well. It is, indeed, one of the best known and one of the most honoured of all fishes. Even as far back as the days of the cave man, it won recognition. This is borne out by a discovery made not many years ago by a group of archaeologists

digging in the Pyrenees in southern France. There they unearthed a piece of reindeer bone on which was carved a picture of a salmon. Discovery of the bone was important in itself, but what was more important was the fact that it had been carved about twelve thousand years before the birth of Christ!

Centuries after the cave man made his carving, Julius Caesar led his victorious armies into Gaul and as they spread over the country they saw great hordes of fish leaping in the rivers. These fish were new to the Romans and so enthralled were they by their grace and beauty that they gave them the name *Salmo* — a derivative of the Latin word *salire*, meaning "to leap."

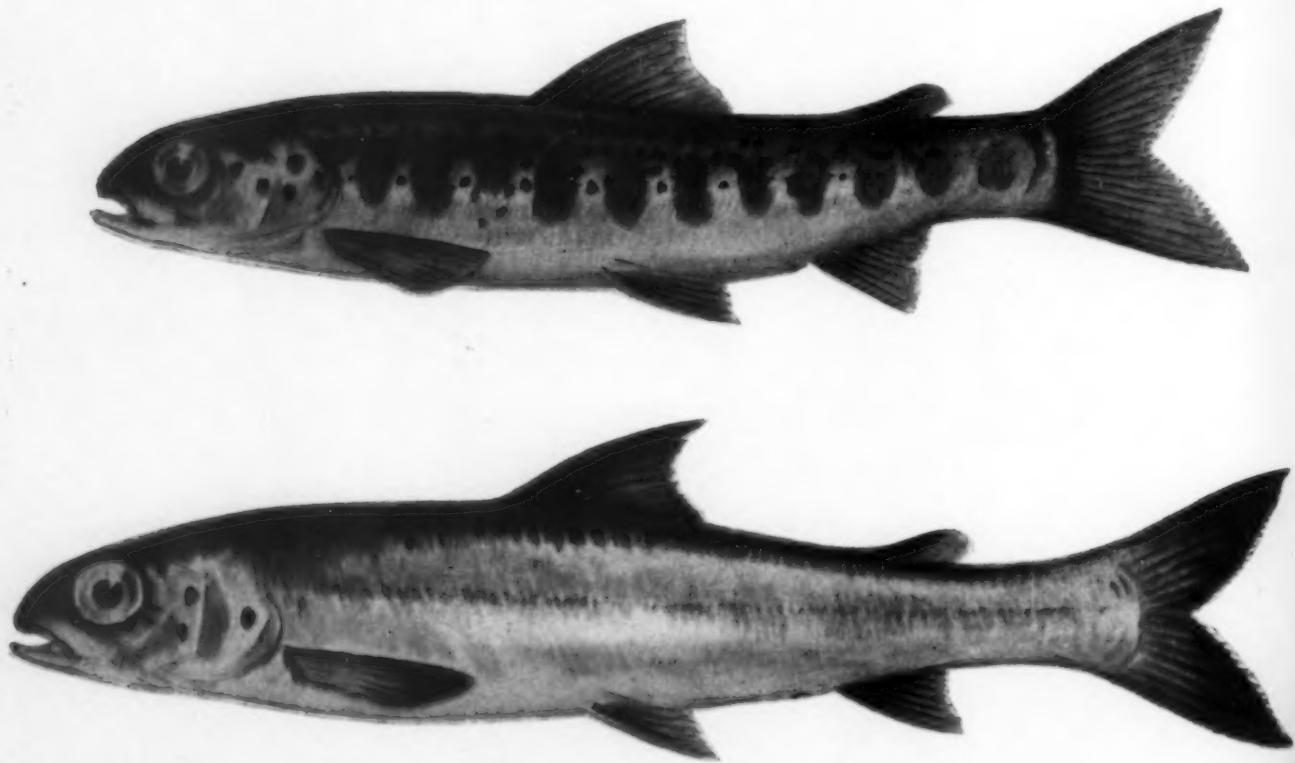
Salmo salar, as they finally became accepted in scientific nomenclature, appear and reappear throughout the history and literature of the past several hundred years. References to salmon are common in the literature and mythology of Scotland and the literature of Ireland, England and Wales; there are references to them in continental literature as well. Three

*Atlantic Salmon — the Romans called them *Salmo*.*



hundred years ago a salt salmon trade existed between Scotland and England, for governances regarding such a commerce were once a part of Scottish laws. As the years passed, however, the popularity of the salmon as a food appears for a time to have suffered. So plentiful did they become in Europe and in North America that contracts for labour stipulated that they were to be served only an agreed number of times each week. During the

though they may be, and capable of amazing feats of endurance and courage in their remarkable migrations from river to sea and return, the salmon need what is a basic requirement of all fish — clean water, and what is particularly necessary to their survival — free access to spawning grounds. Over the years, on both sides of the Atlantic, civilization has dealt the salmon heavy blows, for in many places where man has settled he has carelessly and needlessly



Top:—Salmon parr look not unlike young trout.

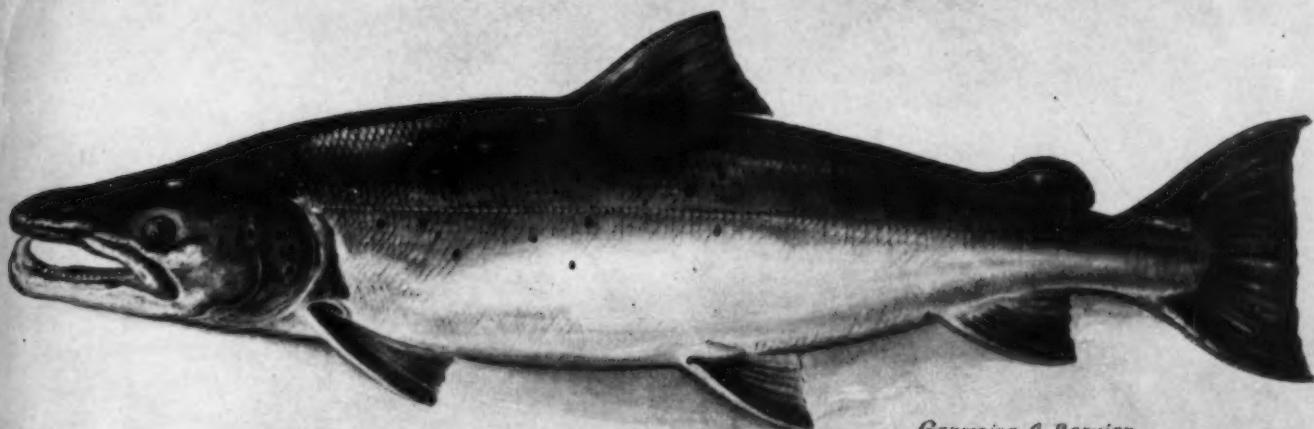
Bottom:—From parr to smolt, and now ready for the sea.

seventeenth century they were so abundant that they were served to domestic help almost every day and came to be regarded as much a staple as potatoes and bread.

But the salmon of the Atlantic were to face an uncertain future — a future that in some areas is probably forever ended and in others is still in doubt. For powerful in strength

stopped free passage of migrating fish or has so polluted the water that none but the lowest of aquatic creatures can survive.

The decline of the Atlantic salmon has been a North American problem for many years. When first this continent was settled by Europeans these fish were common as far inland as Lake Ontario and were known, in fact,



Germaine A. Bernier

With the approach of the spawning season male salmon develop long heads and hooked lower jaws. This fish was caught in fresh water.

to spawn in the headwaters of the Don River not far from the present city of Toronto. Salmon swarmed in such New England rivers as the Hudson, Connecticut, and virtually every Maine river flowing into the sea. Gradually, however, their frontiers were pushed back as communities grew and more and more riverside industrial plants sprang up. The building of dams, the spewing of waste into rivers for easy disposal, reckless deforestation that left streams warm or dried up — these conditions and others spelt death to migrating or spawning fish. That they are now secure mainly in the maritime provinces of Canada (and even in certain areas there they are dangerously few in numbers) is attributable more to slower industrialization than to past foresight or wise management.

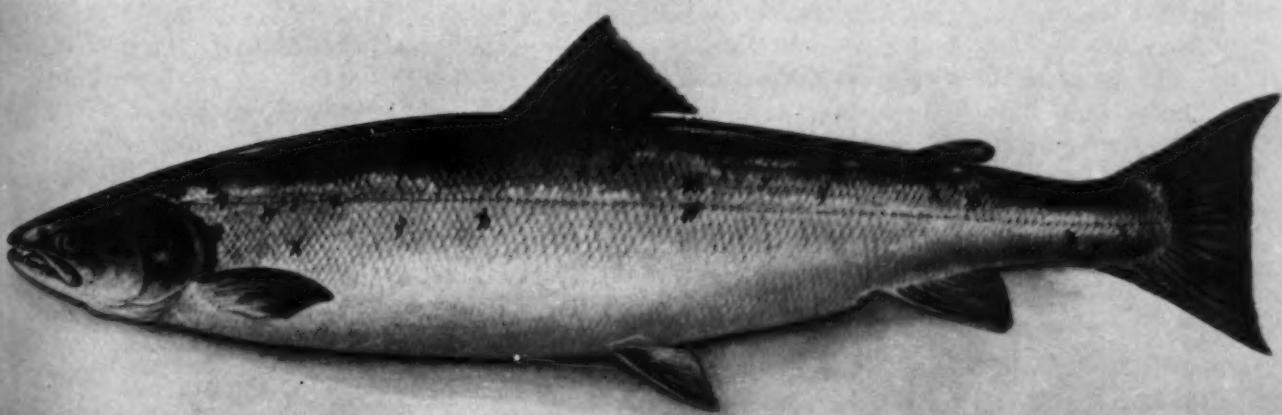
But whatever the faults of the past may have been, there is today a full awareness of the urgency of rebuilding the salmon resource. This

is important to commercial fishermen, who have a logical claim to at least a portion of the stocks; it is equally important to the sportsmen who properly hold to their rights to salmon as a means of recreation. But salmon are, primarily, a food and no nation, in these days of critical world shortages, can stand idly by and allow a food resource to perish. Canada, although rich in other supplies of protein, is conscious of her responsibilities in this connection.

And so the challenge of the salmon has become a challenge of major importance to many Canadians. Governments, both federal and provincial, and sports and commercial fishermen as individuals and as organized groups, are tackling the problem with new determination. For the first time, there is hope that the turning point in the depletion of the salmon is being reached.

To understand the Atlantic salmon is to un-

In their prime, salmon are sleek and beautiful. This female was caught in salt water.



Germaine A. Bernier

derstand, too, something of the Pacific salmons. There is but one Atlantic salmon — *Salmo salar* — but there are five distinct Pacific species, each differing in size, habits and quantity — but each in fabulous abundance. These five species are: sockeye (*nerka*), pink (*gorbuscha*), coho (*kitsutch*), chum (*keta*), and spring (*tschawytscha*) and all belong to a genus bearing the scientific name *Oncorhynchus*. The Atlantic salmon and the Pacific salmons are, of course, anadromous; that is, they are born in fresh water, spend part of their lives in salt water and then return to fresh water to spawn. But the interesting difference is that the Pacific salmons spawn but once and then die, whereas some Atlantic salmon may live to spawn again and again.

The Life Cycle

In the autumn, in several hundred rivers and streams in Quebec, New Brunswick, Nova Scotia, Newfoundland and Labrador, mature salmon, having arrived that year from the sea, leave the quiet of the deep pools and move to shallower and faster waters. There, heavy with milt or ova, they begin one of the most fascinating of all Nature's spectacles — their spawning.

Gone now is the iridescent sheen of steely blue that covered their trim backs, and gone, too, is the silver of their bellies. Their spawning garb is more in tune with the sombre woodland colours that follow the brilliant shades of autumn, and they blend into the mottled bottom of the river bed.

The males, especially, are creatures of changing forms. Sleek and beautiful when first they enter the rivers, they tarnish rapidly under the influence of fresh water and the passing of the weeks. As spawning approaches, their lower jaws develop pronounced hooks and their teeth become enlarged and razor sharp; in these characteristics they are much like their Pacific cousins.

At spawning, the salmon, in pairs of male and female, build their nests or "redds" in the gravel of the river bed. As the male stands guard, the female turns on her side and by fanning her tail scoops out a hollow some twelve to eighteen inches deep. When this has been accomplished, both fish settle over the depression. Soon the

female expels a few eggs which are then covered by the whitish milt of the male. Then the eggs, carried by the current, find their way into cavities of the redd. A number of such nests may be made and several days pass before the spawning has been completed. It is believed that each female deposits about 800 eggs for every pound of her weight.

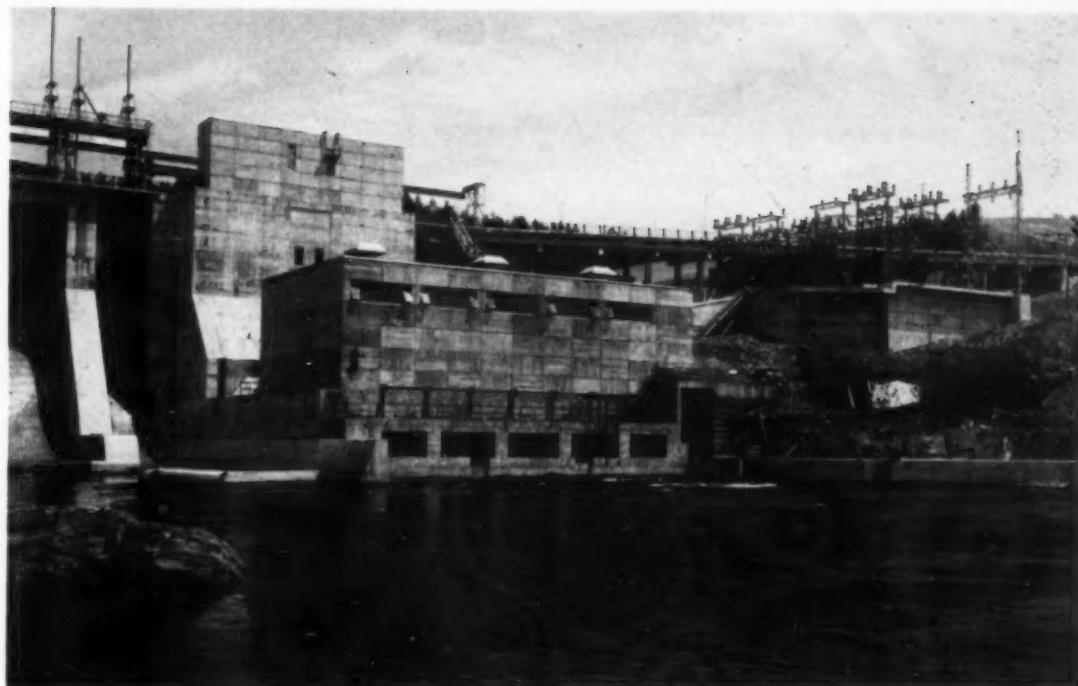
The spawning act is an ordeal for the salmon and sometimes the mortality rate in both sexes is high. But those that do survive either return to the sea before the freeze-up comes or remain in the deeper pools throughout the long winter months. The seaward migration of the winter-bound fish, which are then known as spent salmon, kelt or black salmon, takes place early the following spring just before the main runs of incoming salmon begin.

Meanwhile, in the eggs that were spawned in the fall, rapid development takes place. The throbbing creatures within grow larger as they assume the distorted, but nevertheless certain, shapes of small fish. Early in the spring the eggs hatch and the fry or "alevins" break out of their shells. For about a month they are dependent for nourishment upon a yolk or food sac, but eventually this is absorbed. At that time they emerge from the protection of the reds to become free-swimming and to find their food from the microscopic life of the streams.

As they grow, they acquire brownish backs, with black spots extending down the sides with a few red spots in the vicinity of the median line; their bellies are light grey, cream, or silvery, depending on their habitat. Usually from nine to thirteen dark bars show clearly on each side. At this stage they are known as "parr" and look not unlike the young trout with which they freely mingle in the streams. Growth is slow and when they are ready to leave fresh water for their journey to the sea the young salmon, two to seven years of age, may weigh only a few ounces and be no longer than three and a half to seven inches.

Young salmon begin their journey to the sea in the spring and as they head for the brackish water at the river mouths, their bodies take on a silvery colouring. Their tails lengthen noticeably and become less forked. At this stage they

Industrial development is compatible with conservation of the salmon. Right: a hydro-electric power station at Tobique Narrows, New Brunswick, showing fish escapement at power house face. Below: part of the fish escapement through which salmon ascend the eighty-foot dam.



are known as "smolts". Eager, full of the perfection of youth, they seem to sense the great adventure before them. Now there is no lingering, and often it takes but one rise and fall of the tide to carry thousands of them into the obscurity of the sea that will be their home until they respond to the call of their own spawning.

Science knows little about the wanderings of salmon at sea, but it is known that once in saltwater, they grow at a terrific rate. Food is plentiful and the young salmon gorge them-

selves on the smaller creatures such as fish, shrimp, sand eels, and various kinds of marine worms and crustaceans. As the months pass, they turn to more substantial fare, like the herring, a fish that is itself highly nourishing and that probably contributes more to their rapid growth than anything else.

But as the salmon prey upon other creatures so, too, are they preyed upon. In fresh water they have to contend with a wide variety of natural enemies, such as kingfishers, mergansers, eels, and trout; in salt water they meet new predators — conger eels, seals, tuna, swordfish, and not infrequently cod. Nature, however, works out her own balances and where man does not interfere both predator and prey usually manage to survive and even flourish.

The sea life of the salmon varies from a year to five years and during that time they grow anywhere from three to sixty or seventy pounds in weight. But age does not always determine size, for occasionally a three-year fish will attain a weight twice that of a fish that has been in salt water a year or two longer. Whether this is an inherited condition or one that is determined by other factors, such as water temperature and availability of food, is not known. As a general rule, salmon returning after about a year at sea attain a weight up to six pounds, a two-year fish may weigh from ten to twenty pounds, and a three- to five-year fish may be correspondingly heavier. The average size of a mature salmon, however, is about fifteen

pounds, although specimens of thirty and forty pounds are not uncommon. It is only rarely that a fish of much greater size is taken.

But whatever their age or their size salmon return to their native rivers with a great abundance of stored-up energy.

Even before the floods of the early spring — which carry to the sea those fish that remained in the river following the previous year's spawning — the first incoming runs begin. These early fish are always in magnificent condition and are the most eagerly sought by commercial fishermen and anglers. Their bodies are strong, well-proportioned, blue-black and silvery in colour, and their flesh is red and firm. Shortly after this first run the "grilse", or "jumpers", make their appearance. These are fish weighing from three to six pounds that have spent about a year at sea. Usually, they enter the rivers in a body and, while they are thinner than the full-grown salmon, they are freer and more graceful in their movements and more inclined to make the long and spectacular leaps out of water. Then follows run after run of mature salmon, slackening somewhat during

the hot days of August, and renewed again in September and October when the late fish leave the sea.

The early runs move upstream slowly, migrating mostly at night. In them the milt and roe have barely begun to develop and so they do not have the same sense of urgency that characterizes the later and more fully developed fish. The first salmon find the going easy, for an abundance of water in the rivers makes it possible for them to move freely over the long, flat stretches and to climb the numerous rapids and falls along the way. Often these fish will stay for days at a time in the same spot, motionless except for the movement of their fins and gills. Then, just as suddenly as they appeared they disappear, to be seen in another pool or resting place farther upstream.

As the season advances the rivers enter the low-water stage. Many of the resting places of the early run fish are now high and dry and the once deep channels are shallow and narrow. New arrivals in the estuaries, their spawn heavy and well developed, impatiently cruise in and out with the tide, waiting for rains to raise the water levels and make it safe for them to begin their journey upstream. Once they enter fresh water they press forward and often they can be seen, their dorsal fins out of water, literally pushing their way over the shallows.

The speed of the upstream migration depends on water conditions and the distance the fish have to travel. Like the Pacific salmon, most Atlantic salmon are believed to return not only to the river that gave them their birth, but often to the very stretch of gravel where they were spawned. And so the journey may be long or short. Salmon that spawn in the lower reaches may arrive at their destination within a few days, there to remain for the rest of the summer and fall before spawning. Other fish, with longer journeys ahead of them, may travel for weeks and have only a short time to rest before their seeding begins. On the other hand, a late-run fish, still bright with the silver of its saltwater livery, and perhaps still carrying sea-lice, may be found in a pool with fish that came in early and have become blackened by their long stay in fresh water.

The upstream migration is often difficult,



A commercial fisherman in Saint John, New Brunswick, harbour.

CANADA'S ATLANTIC SALMON

for there are few salmon rivers that are without rapids and treacherous waterfalls. Such a river is the La Have in Nova Scotia. A good salmon river, it contains several long stretches of turbulent rapids, culminating at its upper reaches in falls with a drop of about fifteen feet. Salmon by the score congregate at the foot of this obstacle, known as Indian Falls, and singly, or several at a time, they strive to leap the great height. It is a fascinating sight, a spectacle of rare determination and high endeavour. To watch them pit their own relatively fragile strength against the powerful rush of the torrent, and to watch them succeed, is to watch the salmon at what must surely be the peak of their courage. It is a humbling experience.

With the coming of early winter the last of the spawning salmon will have reached their destinations. Save for an occasional late-comer, most of the lower pools are now empty. The tides in the estuaries rise and fall, but in them no salmon are to be found. But at the headwaters, often deep in the forests, a great horde, disfigured and bearing the scars of long journeys, completes the fulfilment of its supreme task. New life comes from old as millions of eggs — the salmon of the future — are seeded in the gravel beds. Wearily the parent fish slip back to still

waters to live or to die, whatever their destiny may be.

The Commercial Fishery

In the ocean at all times are stocks of salmon of various age groups. Some are young fish that have been in salt water only a short time, others are fish that have spent several years in the ocean's depths growing, maturing, and awaiting their time to return to the rivers to spawn. And so every season runs of salmon head for fresh water in great homeward migrations. The routes they follow are generally well-established, and it is along these routes that commercial fishermen operate.

The commercial salmon fishery, as it is carried on today, is relatively new, although the taking of salmon by various means dates back several hundreds of years. It is a fishery with a very short season and unpredictable returns. But the fishery that does operate is well organized and brings to those who pursue it a ready market for their catches. Atlantic salmon, because of their delicate flavour, their rich, firm texture and high protein content, have a worldwide renown, but never are there enough supplies to meet consumer demands.

The commercial fishery has three main methods of operation: by drift-nets in off-shore waters, by trap-nets along the shore, and by trap and set-nets in estuarial waters.

Atlantic salmon drift-net boats.





Taking salmon from a trap-net, Miramichi estuary.

Drift-net fishermen, operating in open waters from small power-driven boats, set out nets ranging from 300 to 675 fathoms in length. These nets, with a minimum mesh extension of four and a half inches, float vertically in the water, the top being held up by a series of floats and the bottom held down by a series of weights. Usually the drift-net fishermen also attach another but smaller net to the salmon net for the capture of mackerel, and in this way they supplement their earnings.

Normally, drift-net fishing is most effective on dark nights when there is a moderate breeze blowing. These conditions help to make the net practically invisible to the fish, and when they swim into it they get caught in the mesh, usually by the gill covers, and are unable to break free. Since the net is fairly flexible, their struggles only entangle them more securely.

The skipper of the boat, which carries a crew of two or three men, relies entirely on his own judgment when he sets out his net. Rarely do Atlantic salmon jump when at sea, and since they cannot otherwise be seen, there is no way of predicting whether the net will be hauled in with a good catch or a poor one; only when the net is taken in the following morning can success be measured.

When the salmon leave the open sea and reach the shallower coastal waters, many of them swim fairly close along the shore-line until they arrive at the river they will ascend. Along this course they are confronted with the fishermen's trap-nets. These extend at various distances from the shore and are made in such a way as to lead the fish into a box-like net to seaward where they become trapped. If they escape these nets by swimming around them, they encounter the same obstacles in the estuarial waters. In estuarial waters, especially upriver, they also run into the set gill-nets. These are attached to the shore and extended outwards in a stationary position, and the salmon get caught in the meshes of these in the same way as they get caught in the meshes of the drift-nets.

Commercial fishing for salmon falls under certain regulations, not only covering sizes of meshes, lengths and depths of nets, but also open and closed seasons. Such regulations are necessary to assure proper escapement of spawning fish, for without a balanced seeding each year the stocks would rapidly be wiped out.

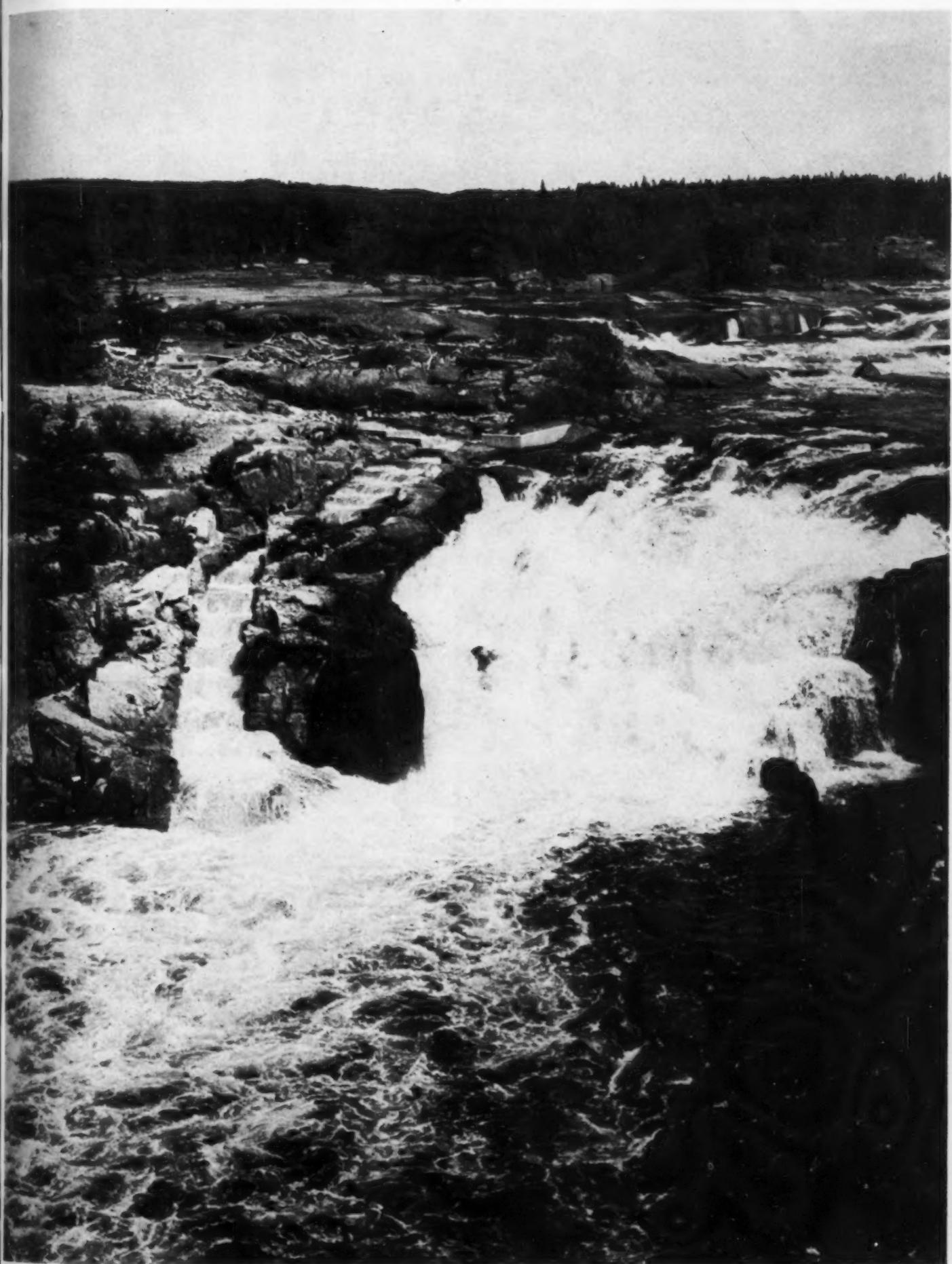
The commercial catch fluctuates in size from season to season, but the average annual catch is approximately 4.5 million pounds, with a value of \$2.5 million. The catch is sold mainly in fresh form, although limited quantities are canned, smoked and salted.

Atlantic salmon is an epicurean delight and not infrequently choice specimens are shipped by air to various parts of the world as gifts to kings and queens, famous statesmen and others. It is, on such occasions, a good-will ambassador for Canada.

The Sports Fishery

Important though salmon may be commercially, their attraction as game fish also produces considerable revenue for the maritime provinces.

In British Columbia the Pacific salmons, in runs of hundreds of thousands, are essentially commercial fish. The salmon fisheries of that province have an annual marketed value of over \$60 million and give direct employment to some twenty thousand people. Their value as



Natural obstacles to migrating salmon, such as the big falls on the Terra Nova River, Newfoundland, are often overcome by the construction of "fish ladders". This escapement, built by the Federal Department of Fisheries, represents one of the many projects in the Atlantic salmon restoration program.



Atlantic salmon are considered by many as the peer of game fish.

sports fish is, however, significant, but is probably reckoned more in terms of international prestige than in terms of dollars left in the province. Only two of the species — cohos and springs — respond regularly to the anglers' lures.

The Atlantic salmon, on the other hand, attract great numbers of sportsmen from various parts of Canada, the United States and other countries. Sizable sums of money are spent every year in each of the provinces by men and women eager to match their wits with light rods, fine leaders and delicate flies against the strength and cunning of these noble creatures. In addition, private clubs, lodges and other establishments catering to anglers have a heavy investment in buildings and equipment. The operation of these establishments provides employment for a large number of local guides and other help.

The Atlantic salmon, long considered the peer of game fish, have given international recognition to otherwise obscure rivers — for example, Nova Scotia's Margaree and St. Mary's; New Brunswick's Miramichi and Restigouche (location of the famous Restigouche Salmon Club, believed to be the wealthiest and most exclusive club of its kind in the world); Quebec's Bonaventure and Matane; Newfoundland's Humber and Terra Nova, and Labrador's Eagle and Forteau. These, and many others, are famous salmon rivers.

Salmon return to the rivers in the peak of condition, but once in fresh water they practically cease feeding and draw entirely on their stored up fat and energy. Why they respond to artificial flies during their long periods of river fasting is as baffling as it is remarkable. Is it inspired by their salt water feeding habits? Do they have vague memories of the eager feeding of their youth? Do they seize flies out of curiosity or irritation? No one knows for sure. But time after time examination of stomachs has shown no trace of recognizable food. That they do respond to artificial flies, whatever the inexplicable compulsion, is, to an angler at least, all that matters.

A wide variety of flies is used in salmon

angling. There are wet flies for high water, wet flies for low water, and there are dry flies. They come in different sizes, in different patterns, and in an overwhelming range of colours. Their names, too, are exciting; names like Jock Scott, Parmachene Belle, Silver Doctor, Greenwell's Glory, Black Dose, March Brown and a host of others. There is wet fly fishing, dry fly fishing, greased line fishing and drift cast fishing, and there are different techniques for each method. To understand all these things, and to understand, too, the ways of the rivers and the salmon that are in them, requires a lifetime of study and first-hand experience.

But whether expert or novice, the angler who succeeds in raising and hooking an Atlantic salmon finds himself in touch with a creature possessed. The salmon is a courageous, determined fighter that will submit only when its strength is gone; even then its will to live may provide the energy for a final surge sufficient for the fish to regain its freedom from momentarily careless hands. The salmon's long rushes, and frenzied leaps out of water, seldom fail to give the angler everything he could expect in the way of thrills.

There is no adequate explanation of the lure of salmon fishing. To some it is the call of the quiet places, of the cathedral forests of spruce and pine and birches, of the gentle flow of clear, lovely streams, of the sheer poetry of a salmon's rise rather than the struggle that ensues; to others it is the satisfaction of companionship, of salmon talk, of hard strikes and pulsating battles. But whatever its appeal, it is a complicated, demanding art that is as often fraught with failure as it is blessed with success.

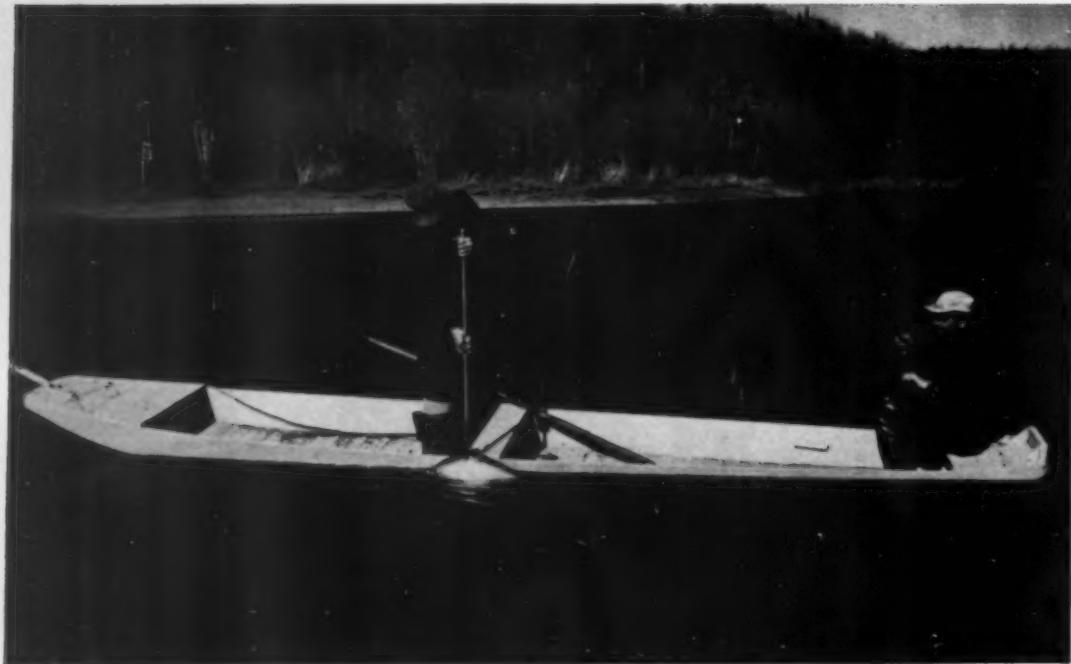
The Future of the Resource

The control of a fishery — any fishery — is one of the most complex problems in the whole area of wildlife management. Man yet knows little of the mysteries of aquatic life, and when these are compounded by the mysteries of the sea, the problem increases a hundredfold.

While much is known about the salmon, there are still many unknowns. Science, working diligently over the years, has been able to record the existence of certain established habits in behaviour and development during



A small one, but worthy game.



A successful day on the Medway River, Nova Scotia.

Anglers find good salmon fishing in Quebec.



stream life; as far as the salmon's sea life is concerned there is still an abysmal lack of knowledge and it may be that Nature will never reveal all her secrets. The sea, despite clever scientific instruments devised by man, has imponderable depths which human vision may never be able to penetrate.

And so known facts, for the present at least, can be supplemented only by surmises. The challenge that faces the scientists is to acquire new knowledge, and this knowledge can be gained only by long and painstaking research and experiment.

One fact, however, is clear: there has been a decline in Atlantic salmon during the past twenty years. The problem now is not only to arrest this decline but to rebuild the stocks.

The starting point of such an undertaking may be anywhere throughout the complicated range of the salmon's life cycle. But there are many factors other than the fish themselves, factors such as predators, water levels and water temperatures, water pollution, both natural and man-made obstacles, size of commercial and angling catches, and the sea itself.

While the problem is essentially one that

CANADA'S ATLANTIC SALMON

belongs to the federal government, its solution is also of vital importance to all of the provinces concerned. And so the Department of Fisheries of Canada, together with its Fisheries Research Board, is working closely with provincial fishery authorities and scientists in a united effort to find that solution.

One of the results of this federal-provincial co-operation has been the creation of the Atlantic Salmon Co-ordinating Committee, a body composed of federal and provincial deputy ministers of fisheries, administrators, and

scientists. This group formulates policy for recommendation to governments and decides on research and management programs. The practical work, in turn, is carried out by a scientific sub-committee, a unit made up of scientists of the federal and provincial departments concerned with fisheries and of the Fisheries Research Board.

The committee, and its sub-committee, have the co-operation of private groups and individuals. Prominent among these is the Atlantic Salmon Association, an organization of anglers



Indian Falls, on the La Have River, Nova Scotia, before the Department of Fisheries constructed a salmon escapement.



Salmon have brought international fame to a number of rivers; such a one is the Humber, in Newfoundland.

affiliated with the Salmon and Trout Association of Great Britain. This Association, created in 1948, has shown a keen interest in the welfare of the resource and in the salmon rehabilitation program. In addition, help has come from various fish and game clubs, from commercial fishermen, outfitters, guides and anglers.

Reduced to its simplest terms, the objective of the undertaking is to rebuild the stocks of salmon wherever declines have been noted. This involves a whole set of problems, complicated by the fact that no two rivers are ever alike and no simple formula can fully answer every need. And so each river requires its own special study and its own special remedy.

But for every river there are certain basic requirements. A river can successfully propagate salmon only if its water is clean and fresh, with a steady flow throughout its length. Its nursery areas must be sufficient in extent to meet the needs of spawning fish and these areas must be protected so that they will safely hatch the eggs deposited in them. A river must be reasonably free of predators — of the trout that eat the eggs and fingerlings, of the kingfishers, otters, mergansers and other creatures that destroy the parr and the smolts. It must be free of impassable barriers that block the ascent or descent of migrating fish, and it must be without pollution. In the

estuaries leading to the open sea there must also be clean, unpolluted water. And along its whole course, it must be without that human destroyer — the poacher. With all these, along with a regulated sports and commercial fishery, a salmon river may be said to be in ideal condition. But still there remains the sea itself, the hidden depths where salmon spend about a third of their lives. What happens to the salmon once they reach these unknowns? Here, indeed, is the great imponderable.

The resource, itself, is a complex one with Nature maintaining controls around which most man-made controls must revolve. Studies made of the Atlantic salmon show that natural mortality is high. It must be assumed that before man began to exploit the resource, regardless of the number of eggs spawned and hatched, only two — one of each sex — escaped the many natural causes of destruction along the way and returned to the rivers as adult fish, there to spawn and carry on the race.

This "two for two" ratio, which applies to all other forms of wildlife, is Nature's own system of management, and in itself is sufficient to perpetuate all creatures in proper balance. When the ratio is upset and becomes much less than two for two, declines follow. Presumably, that is what has happened in the case of the salmon.

The question is, then, what has upset the



Atlantic salmon counting fence on the Northwest Miramichi River, New Brunswick.



Artificial propagation is an important phase of salmon rehabilitation program. Spawning shed and salmon ponds of Miramichi Hatchery, Newcastle, N.B.

ratio? In their natural state, before the coming of man and the encroachment of his civilization, rivers were believed to have supported tremendous runs of fish. With man's arrival things happened. He cleared the forests, often to the rivers' edges, taking away the protection that prevented silting and the drying up of river beds; he built communities alongside rivers and used the water for the disposal of human and industrial waste; he built dams and other establishments that completely altered water levels, with never a thought to the needs of migrating fish, and he killed fish for food or for sport.

Any one of these conditions can adversely affect a fishery; pollution alone, for example, is sufficient to destroy runs of migratory species, even though beyond the pollution area other fish may flourish. This applies to dams that block free movement to and from the sea. But a river free of poisons and obstructions can still be ruined by other man-made causes. Natural predation, such as that by animals, birds and fish, normally would not be serious, but when this predation is added to other causes of destruction it is a matter of much concern. Scientists now know that the successful rehabilitation of salmon in any river calls for the management of the *whole* river, not merely a part of it.

The program being evolved by the govern-

ment-sponsored Atlantic Salmon Co-ordinating Committee is a long-range undertaking. Some of it is new, some of it a continuation of the regular work of the federal and provincial departments of fisheries and the Fisheries Research Board. In any event, studies are now being made of all of the factors involved. Rivers are being surveyed from their sources to their mouths to determine their salmon population capacities, to ascertain location of problem areas and, where possible, to remove such problems. Predator control work, such as reduction of unduly large populations of kingfishers and mergansers, so destructive of parr and smolts, is underway on an experimental

Mature salmon are held in special tanks prior to stripping.





Female salmon prior to stripping. Below, stripping is painless and does not injure the fish.



basis, and is being carried out with the approval of the authorities responsible for the administration of the Migratory Birds Convention Act. Marking of smolts and tagging of adult fish to acquire further knowledge about migration is also underway, as is the counting, by means of specially constructed "fences", of incoming and outgoing fish. Millions of healthy young salmon are being produced in government-operated hatcheries through artificial propagation and released in selected rivers. In the future, as in the past, fishways will be provided wherever impassable barriers occur, or are created by industrial development.

But the project is both complex and difficult. As in all fishery problems, much of the knowledge sought by scientists is concealed behind the curtain of deep water. To link the known with the unknown and to obtain correct answers demands both skill and patience.

It cannot be too emphatically stated, however, that the rehabilitation of the Atlantic salmon is not alone the job of governments. Scientific research, the building of fish escapements, control of catches, supervision of rivers and artificial propagation of new stocks, among other measures, are all essential but in themselves are not sufficient. It is an undertaking that will succeed only if there is understanding and co-operation from the public. This applies particularly to sportsmen and commercial fishermen and to water and forest users.

Industrial growth in all of the Atlantic

maritime provinces, especially that calling for the harnessing of water power for hydro-electric purposes, will bring many problems, as will increased population and continued use of forest resources. But these problems can be overcome. In British Columbia where extensive development at one time threatened the great runs of Pacific salmon, experience has shown that it is not necessarily fish *versus* industrial growth, but fish *and* industrial growth. It has been clearly demonstrated that freedom to develop one is compatible with freedom to conserve the other.

CANADA'S ATLANTIC SALMON

The salmon are a part of our great renewable resources and, like all living elements, depend for growth and reproduction on sun, soil, and water. Successful management of agriculture demands intelligent management of soil; successful management of soil demands intelligent management of both woodlots and water. Similarly, successful management of fisheries demands intelligent management of rivers. Experience has shown that most of our living resources are interdependent and are part of an integral whole. To develop or exploit one resource without thinking of the possible detrimental effects on others is to endanger the future of all. Thus, "multiple use" management plans

have largely replaced the "single use" plans which have been proved to be neither sensible nor economic. The conservation of salmon need not retard hydro-electric progress or forest cropping, although on occasions the various interests may have to agree to certain compromises.

As the studies continue, it may be found necessary to redefine existing regulations regarding open and closed seasons and limits of catch, and from time to time the takers of salmon may find their traditional privileges upset. But whatever is done will be done with one objective in mind: to restore the Atlantic salmon in numbers sufficient to overcome permanently the decline and to provide greater stocks for the benefit of all concerned.

When this has been achieved commercial fishermen will benefit through greater economic returns for their labours and anglers will benefit through vastly improved recreation.

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Colour illustrations on page 129
from paintings by Mrs. Germaine A. Bernier-Boulanger
courtesy Quebec Department of Fisheries.



Stripping the male salmon, showing the milt fertilizing the eggs. Right, the hooked jaw of the male salmon indicates spawning maturity.





The Hon. Lester B. Pearson, Secretary of State for External Affairs, speaks at the "Meet-the-Teams" Dinner which preceded the multi-country Canada Cup Matches at Montreal in August. From left to right: M. Samoïsette, pro-mayor of Laval, site of the matches; His Excellency Dr. Lucas Mario Galigniana, Argentine Ambassador to Canada; John Jay Hopkins, president of the International Golf Association and donor of the Canada Cup; Mr. Pearson; Councillor Edmund T. Asselin, representing the City of Montreal; Sam Snead, member of the American team in the matches; and J. P. Emile Collette, director of the I.G.A. and honorary president of the C.P.G.A.

Goodwill Through Golf — The Canada Cup

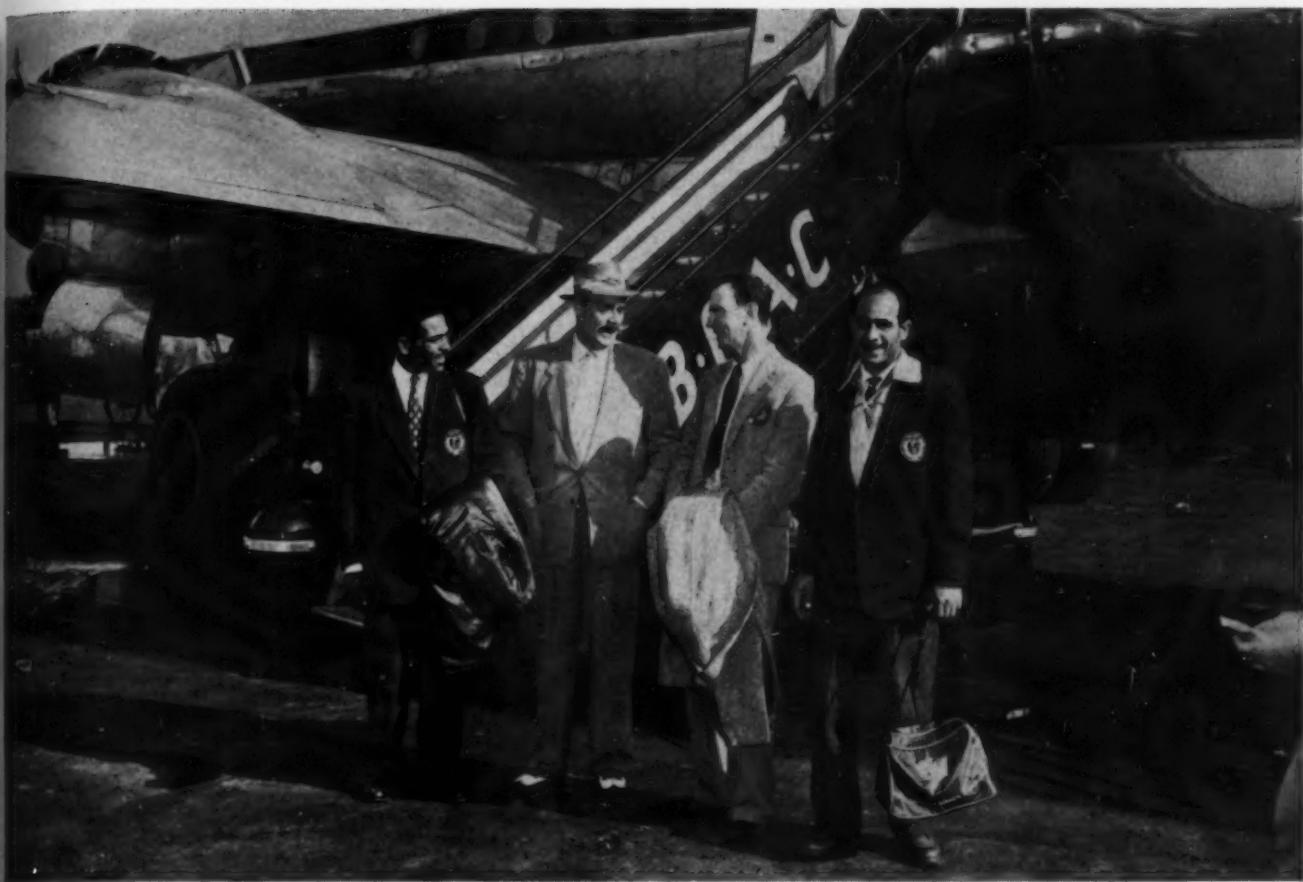
by LES POWELL

SOME years ago an attempt was made to promote the use of Esperanto as an international language. It did not succeed. Perhaps until rates of literacy have become relatively equal in all countries and there is free mingling of men everywhere, a common tongue will not be adopted. But participation in a common sport overcomes barriers of speech and custom.

The golfers who attended the Canada Cup Matches at Laval-sur-le-Lac Golf Club near

I.G.A. photographs by Davidson

Montreal in August this year might go so far as to declare that golf, itself, had become a kind of international language. There was a feeling in the air during the matches which warmed the heart of every person present, whether he was a participant or not. This feeling, indefinable though it was, must have gratified the planners of the tournament, for the matches were inaugurated for the specific purpose of using golf to spread international goodwill.



At Montreal airport Leslie C. Powell (with hat) general manager of the International Golf Association, welcomes (from left to right) Cherif Said, Egypt; Bert Thomas, South Africa; and Naaman Aly, Egypt.

Harry Weetman, a member of the English team, signs the Golden Book in Montreal's City Hall during the official civic reception which preceded the matches. From left to right: Flory Van Donck, Belgium; Georg Bessner and Friedel Schmaderer, Germany; Otto Schoepfer, Switzerland; Aldo Casera, Italy; Arthur De Vulder, Belgium; Jean Garaialde, France; Eddie Fennell, New Zealand; Harry Bradshaw, Ireland; Francois Saubaber, France; Carl Paulsen, Norway; Ugo Grappasonni, Italy; Tom Haliburton, Scotland; and Dai Rees, Wales.





The start of the Canada Cup Matches at Laval-sur-le-Lac Golf Club, Montreal.

Until recently golf events were domestic affairs, though occasionally there had been a few foreign entries in them. No international tournament existed. However, last year one was held in Montreal for the first time—the Canada Cup Matches, sponsored by the International Golf Association, a chartered non-profit organization, whose founder and president is John Jay Hopkins, an internationally known industrialist who organized the tournament and donated the Canada Cup. Eight countries took part and seven two-man teams competed. The tournament went off well. In fact, its success extended far beyond the expectations of the Association and its officers, for when invitations were issued to play in the 1954 event, representatives of twenty-five countries accepted them. At last there was going to be a real international tournament: it remained to be seen whether out of it would grow the something else in which its organizers were interested—a spirit of international *camaraderie*.

When the last putt had been sunk on the tricky 18th hole while some 10,000 excited and enthusiastic fans looked on, it was clear that

the goal of Mr. Hopkins and his associates had been attained. Writers from more than half a dozen countries hurried off to the press room to file thousands of words that fairly danced with superlatives. One man proclaimed that “the greatest international golf tournament of them all was a success from every viewpoint”. Others asserted that the Canada Cup Matches were “the Olympic Games of golf” and that “they will develop into one of the great sports classics of our times”. From one of the players themselves, Jimmy Demaret of the American team, came the tribute which summed up everyone’s feelings: “The Canada Cup Matches are the United Nations without doubletalk!”

The task of bringing together players from all over the world for the matches had been no small one, nor had expenses been negligible. The Association paid travelling and other expenses. It also awarded an honorarium of \$500 to each player. Yet there had been no tendency by members to weigh time, effort and dollars against their ideal. It was not surprising to find that others felt the same way. From almost every country participating in the matches came offers to play host sometime in

GOODWILL THROUGH GOLF

the future. However, it seems likely that for the next few years the tournament will be played on Canadian greens.

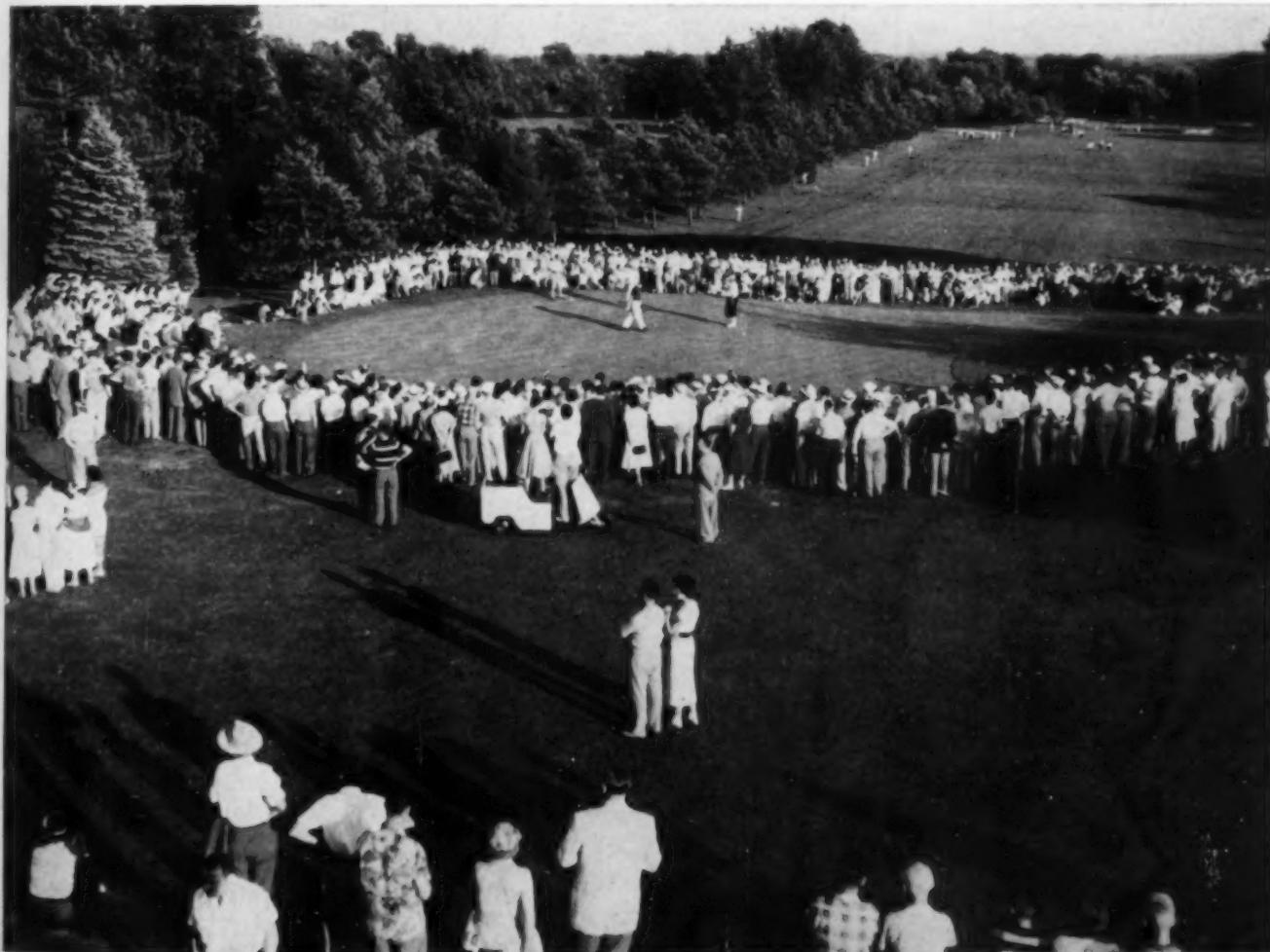
In an address of welcome to the players the Rt. Hon. Louis St. Laurent, Canada's Prime Minister, personally endorsed the aims of the I.G.A. "Such meetings, held as they are in an atmosphere of friendship and good sportsmanship," he said, "contribute to better understanding among the nations concerned." Similar sentiments were expressed by the Hon. Lester B. Pearson, Secretary of State for External Affairs, when he spoke at the dinner, attended by diplomats, businessmen, and sportsmen, which preceded the matches. Mr. John Jay Hopkins, speaking to the same group, said that he anticipated the day when I.G.A. would have patrons all over the world and when the Canada Cup Matches would be recognized as being as much a part of international sport as the Davis Cup matches. Henry Longhurst, the well-known English sports-writer, was moved to suggest on the

spot that the matches be played at Scotland's famous St. Andrews.

"This is a wonderful conception," he declared. "Last year there were seven teams. This year there are twenty-five nations represented. The Royal and Ancient Golf Club was established in Scotland in 1754 with twenty-two noblemen and gentlemen. Here in Montreal we have more nations represented than charter members of the R. and A. I feel sure that the Royal and Ancient Golf Club would be delighted to entertain this great international match. It definitely should be played over the old course at St. Andrews, the headquarters of world golf."

The enthusiasm and optimism of those who made the speeches still lingered in many minds on the opening day of the matches. The weather could not have been better. And crowds of spectators swarmed through the main gate of Laval-sur-le-Lac Golf Club in numbers that astonished the officials. Never had so many people attended the opening of a

Large crowds watched the United States-South Africa match which featured Sam Snead and Jimmy Demaret of the U.S., and Bobby Locke and Bert Thomas of South Africa.





The English and Argentine teams on the first tee. Left to right: Harry Weetman and Peter Alliss, England; Mr. Hopkins; Antonio Cerdá and Roberto De Vicenzo, Argentina, defenders of the Cup.

Below:—Mr. Hopkins, stands between the members of Canada's team which finished fourth. At left is Jules Huot, home pro at Laval-sur-le-Lac, and at right Stan Leonard of Vancouver, who was low medallist.



three-day golf tournament in Canada.

The players came from the plains of Australia, the pampas of South America, the veldts of South Africa, from the shadows of the pyramids of Egypt and the foothills of Switzerland. Their names, as they were called forward to the first tee to be introduced in English and French, sounded like a roll-call from the Who's Who of the golfing world—among them Sam Snead from the United States, Bobby Locke of South Africa, Ireland's Fred Daly, Dai Rees of Wales, Australia's Peter Thomson, Alberto Salas of Chile, Canada's Stan Leonard, Aldo Casera from Italy and Robert Lanz of Switzerland. It was a gathering to satisfy the dreams of amateur golfers the world over.

The play, itself, was brilliant. Up till the last round spectators were kept in suspense about the outcome. A smiling young team from Australia, Peter Thomson and Kelvin Nagle, at last emerged as victors with a combined gross score of 556 (twenty strokes under par).

GOODWILL THROUGH GOLF

To them went the \$5,000 trophy, held since 1953 by the defending champions from Argentina, Tony Cerda and Roberto De Vicenzo.

The winners, Nagle and Thomson, did not attain an easy victory, but their many sub-par rounds did the trick. After the first day they led. Half way through the matches the Argentinians had tied with them for first place and teams from three other countries were tied just three strokes behind. These were the Americans, Snead and Demaret; the surprisingly strong pair from Scotland, Eric Brown and Thomas Haliburton; and the Canadians, Stan Leonard and Jules Huot.

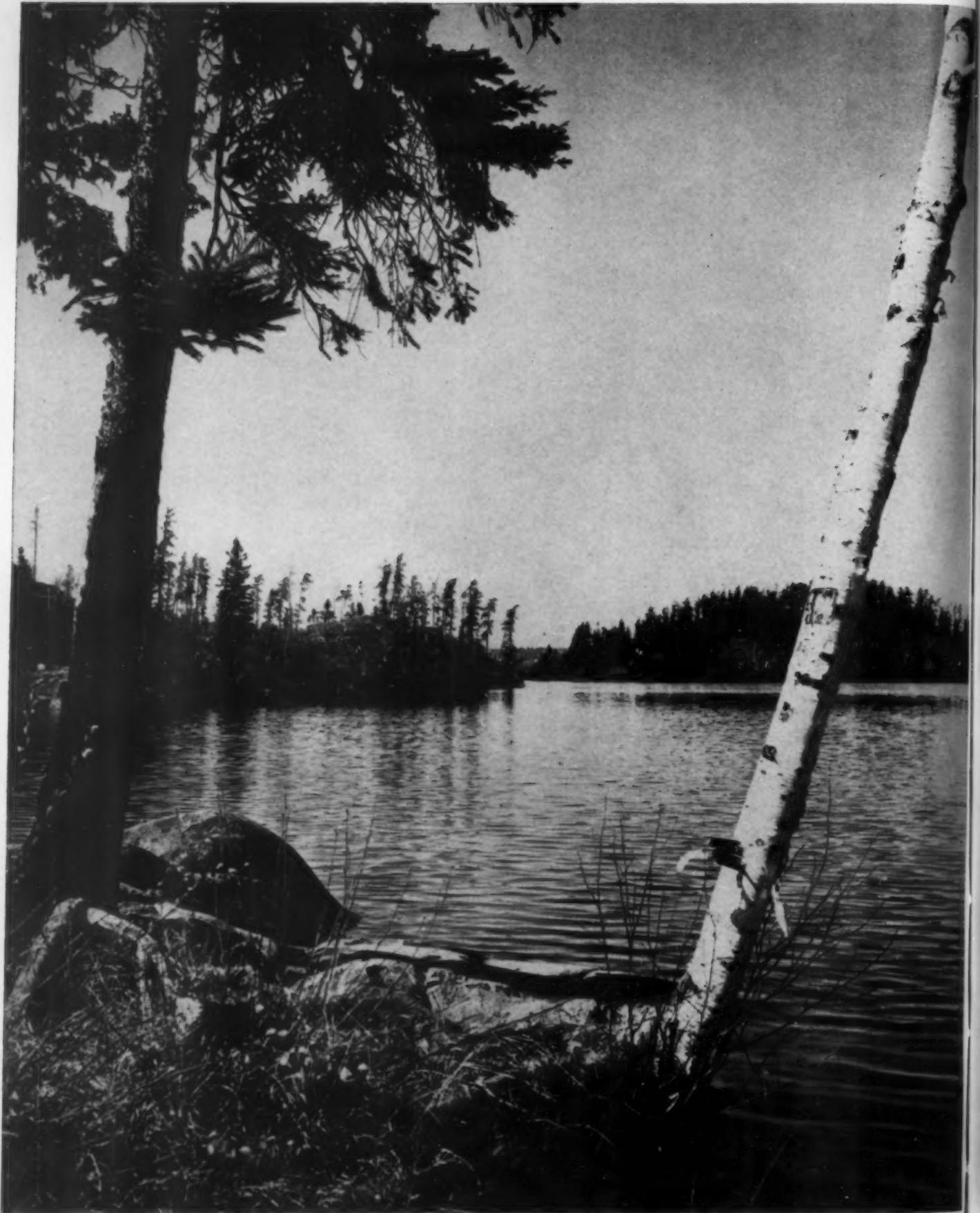
By the time the tournament was three-quarters over, the Argentinians, whose Tony Cerda did the course in sixty-seven strokes, were leading by two strokes. The battle was now between them and the Australians. Most of the spectators followed the play over the course and none of them was disappointed, for the competition was keen. The Australians, however, finished four strokes ahead of the Argentinians with a score of 556 to their 560.

The Americans, whose Demaret had the best scores, came in with 565, followed by the Canadians with 570 and the Scots with 571. Particularly pleasing to the host country was the outstanding performance of Stan Leonard. After four brilliant sub-par rounds, one of which was sixty-six on opening day, he finished the 72 holes thirteen strokes under par. He received the largest part of the \$1,800 awarded by the committee for bonus birdies and eagles.

Results are interesting, but they are not as important as the fact that so many international masters of one sport actually met on one green. That it happened to be the green of a Canadian golf club we may be proud, but we should look to the day when Canada Cup Matches, having become the established annual international tournament for golfers, will be held in turn in every country where golf is popular. Then the International Golf Association's intention of promoting goodwill through golf will have been realized to the full. In two years the Canada Cup Matches have made a remarkable beginning in that direction.

John Jay Hopkins, president of the International Golf Association and donor of the Canada Cup, stands behind the magnificent trophy with the winning Australian team of Kelvin Nagle (left) and Peter Thomson. The trophy, largest ever made in Canada, weighs 97 pounds and cost more than \$5,000.





A light evening breeze ripples the waters of Otto Lake, not far from the settlement of Kirkland Lake in Northern Ontario. Set in the unspoilt grandeur of northern woods and rocky, lake-strewn country, Otto Lake lies in the shelter of tall, dark spruce trees and graceful birches. The cool waters of this lake on the Precambrian Shield abound with pike and pickerel.

Fred Bruemmer



Pictures of the Provinces — IV

The quiet, pastoral beauty of field and stream is one of the appealing aspects that New Brunswick has to offer. Rich meadowland contrasts with rocky headlands and fishing villages in this province of widely varied scenery and activities.

New Brunswick Travel Bureau



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New Brunswick Travel Bureau



Kitimat—A Saga of Canada

by PAUL CLARK

LEGENDS of the Indian tribes who lived along British Columbia's northwest coast tell of the Thunderbird, a creature of gigantic size that dwelt in such rocky fastnesses as those around Kemano, where today power is generated for the new aluminum smelter at nearby Kitimat.

When the Thunderbird became hungry it covered itself with feathers and sallied forth in search of food. As it passed overhead the heavens were darkened; the working of its giant wings made thunder roll up and down the mountainous valleys, and lightning flashed from its body.

This primitive symbol of nature's power could also serve as a fitting symbol of the Aluminum Company of Canada's great new Kitimat development. For man-made power, hydro-electric power, is the keynote in the saga of the new aluminum smelter at Kitimat and the powerhouse at Kemano.

So this is a story of power in the wilderness; potential power long unused and wasting, but now captured and put to service so that North America and all the free world have another major source of aluminum.

Above:

Tangled underbrush, forbidding forests and snow-clad hills confronted the first pioneers to inspect the site of the future city of Kitimat — a city that will eventually be the home of 50,000 people.

Potential Horse-power

High in the mountains of central British Columbia, 400 miles north of Vancouver and 100 miles south of Alaska, are long, narrow lakes whose beds were gouged from granite during the ice age. Fed by glaciers and snow-topped mountains the waters of the lakes have for ages flowed eastward then turned south to join the Fraser River and meet the ocean at Vancouver.

"A terrible silence, broken only now and again by the dreadful crash of some falling avalanche, reigned over this scene of desolation." Thus wrote Charles Horetzky, surveyor for the railroads in 1874. Searching for a pass through the mountains where a railway could be built, he had led a party of three white men and four Indians to the top of a pass on the mountainous north shore of British Columbia. As he stood there awed by the silence, looking at the "lake of a brilliant light blue colour" (Tahtsa Lake), Horetzky could not foresee that 80 years later the scene would be the centre of an aluminum industry—a metal he probably had never seen.

These lakes were surveyed in 1928 by provin-

KITIMAT—A SAGA OF CANADA

cial engineers of British Columbia. The interest of government hydro-electric engineers was aroused since Tahtsa Lake, the most westerly water in the intricate and connected chain, was only ten miles away from and one-half mile above the Kemano River and sea water. However, high-in-the-clouds Tahtsa Lake and sea-level Kemano River were held apart by a great mountain. This barrier of nature presented many problems. How could man pierce the mountain and allow the waters to drop to sea level? Could the eastward flow be reversed and turned to the west? And who would use the power if it could be made? A quarter of a century ago there were no answers to these questions so the surveys and the reports were laid aside awaiting a day when the answers would be found.

This, then, was the situation for many years. British Columbia officials often wondered what could be done to use the lakes and their potential power. After fruitless inquiry at many places, the officials invited the Aluminum Company of Canada to send engineers to inspect the site and determine whether the wasting waters could be put to service. Early in 1951 Alcan accepted nature's challenge, and started work on the vast Kitimat Project, the largest job ever undertaken by private enterprise.

Before looking at the engineering feats performed in the intricate and complicated Project, let us glance back briefly to the story of the aluminum industry in Canada and the progressive steps which led to the British Columbia Development.

Power, the Key to Aluminum

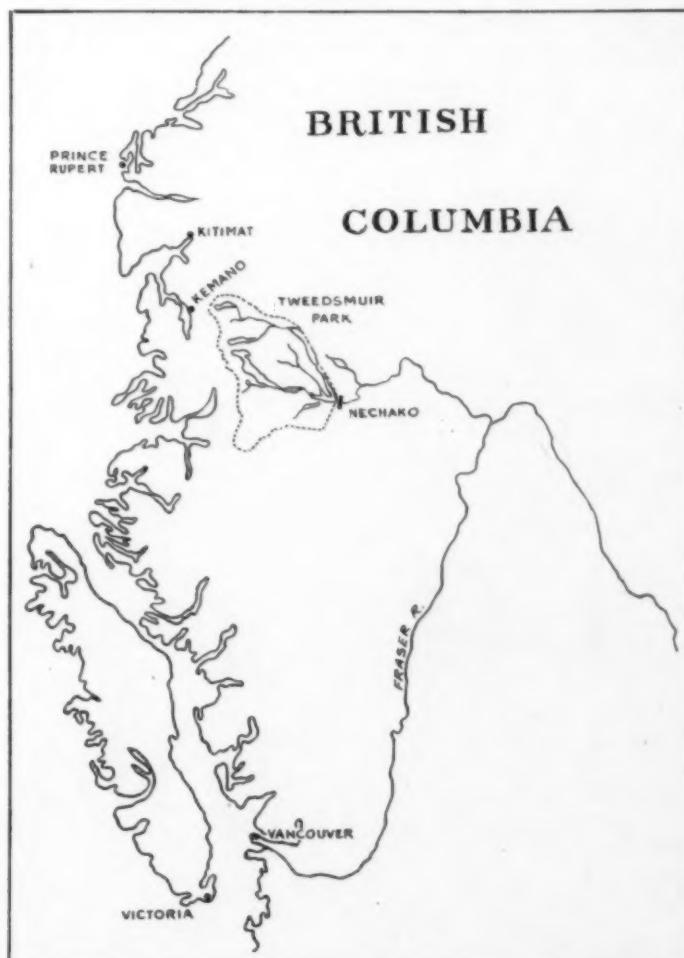
Aluminum is a relative newcomer to the list of metals which man has learned to put to daily use. It is probable that the grandparents of some of us never saw a piece of aluminum! A hundred years ago aluminum was so rare that it was still in the same costly category as gold and silver—too expensive for practical things. It remained for a twenty-two-year-old—Charles Martin Hall of Oberlin, Ohio—to evolve in his woodshed laboratory a commercially practical electrolytic process for extracting the metal from bauxite ore. His basic process has made

possible today's mass production of aluminum.

Of great future significance to Canada was the fact that Hall's method demanded large quantities of electricity. It takes 20,000 kwh of electrical energy to process one ton of aluminum—enough power to serve the average Canadian home for twelve years. And last year Canada produced more than a billion pounds of the metal!

Power, therefore, is an essential key to low-cost aluminum production. Canada's abundant water power has helped to make her the world's second largest aluminum producer—the United States is first—even though Canada has no bauxite, the reddish-brown ore from which the metal is extracted.

The second essential key to the production of Canadian aluminum is transportation—because bauxite, the ore from which aluminum is made, is found principally in tropical countries. Canada obtains its ore from British Guiana, West Africa and Jamaica. There in





Hardy survey crews spent three years measuring an area the size of the state of Connecticut. From lonely cabins on the shores of wilderness lakes, they sounded strange waters and ventured into new lands. From their data books, other engineers drew maps and changed the unknown into the known.



the hot jungles on the land area banding the equator, bauxite is plentiful. After the jungle growth and overburden are cleared away, the bauxite pockets are exposed. Mining is performed by open-pit method, the ore loaded on rail hopper cars and moved to a river or seaport for transfer to large ocean-going vessels which then start the long 3,000-mile voyage to Canada.

Just as Canada is favoured with water power so is she blessed with a long seacoast and deep harbours to receive ocean vessels carrying the raw material.

The Quebec Development

The need for this combination of power and port facilities led to the selection of Shawinigan Falls, Quebec, as the site of Canada's first aluminum smelter. There, in 1900, large new power installations were the powerful magnet which drew the aluminum industry as the first

Top engineers engaged in the preliminary surveys for the Kitimat project. Seated in the helicopter is Alcan Vice-President and General Manager A. W. Whitaker, Jr., in charge of all engineering for the vast undertaking. With him is P. E. Radley, Project Manager, and at the right Jack Kendrick, Assistant Project Manager.

Grand Canyon of the Nechako River during low water season. Shown in outline is the site of Kenney Dam.

power user in the almost uninhabited St. Maurice Valley. And just a few miles downstream from Shawinigan Falls were the docks of Trois-Rivières, where the foaming St. Maurice River joins the broad St. Lawrence with access to the Atlantic Ocean.

The Shawinigan Falls aluminum smelter sufficed for about 25 years, but towards the end of this period growing world markets called for expanded output. However, because of the expansion of the chemicals and pulp and paper industries in the St. Maurice Valley, more power was not available there to produce more aluminum. It was, therefore, decided to move to the Saguenay District, where immense water power resources remained unused.

The pioneers of power first brought the raging Saguenay River under control in 1926 by the completion of the 540,000 h.p. generating station at Isle Maligne. In that year the new smelter at Arvida went into production on a modest scale. In 1931, the Chute-à-Caron generating station, 20 miles downstream from Isle Maligne, added its capacity of 300,000 h.p. to Arvida. Then in 1943, the great Shipshaw Development was completed. Its total capacity of 1,500,000 h.p. made nearby Arvida works the largest aluminum smelter in the world. Further electrical energy became available in 1952 and 1953 by the addition of two more powerhouses on the Peribonka River at Chute du Diable and Chute-à-la-Savane. Today the flow of waters into the Saguenay River from its watershed area of 30,000 square miles is controlled and regulated by a series of huge dams, three vast storage reservoirs, and five generating stations having an over-all installed capacity of 2,580,000 h.p.

In addition to supplying the power, the Saguenay River also has the navigation facilities for the direct import of raw materials and the export of finished aluminum. Seventeen miles by rail from Arvida are modern large-scale dock facilities at Port Alfred which efficiently handle the deep-sea transportation requisites.

Now at Arvida a great aluminum smelter stretches over an area of one and one-half by three-quarter miles. The City of Arvida, with its population of over 12,000 persons, is still



growing. Additional smelters have been erected at Beauharnois, Quebec, and Isle Maligne, Quebec. Thus today Alcan's four smelters in Quebec Province—at Shawinigan Falls, Arvida, Beauharnois and Isle Maligne—have a capacity of over half a million tons of aluminum a year.

The Kitimat Project

Even as the Quebec projects were under way, Alcan could visualize a still greater demand for aluminum and its engineers were searching in many parts of the world for likely power and smelter sites. In time, their eyes turned to Canada's West Coast.

The British Columbia Department of Lands and Forests, aware that the high level lakes lying behind the coastal range were a potential source of hydro-electric power, had carried out preliminary surveys of the watersheds of the area, first in 1928-31 and again in 1937-39. The results indicated exciting possibilities. But year after year the waters continued to flow unused. At that time no Canadian industry required power so badly that it could afford the heavy engineering and financial responsibilities involved in creating the power development.

The Government of British Columbia asked Alcan to study the surveys but with a second



Waters of the Nechako River rushing out of the temporary diversion tunnel, thus allowing the engineers to scour the bed of the river.

Two-lane, sixty-mile access road from C.N.R. railhead at Vanderhoof, B.C., to site of Kenney Dam. Built in 12 weeks, this highway gave entrance to heavy construction equipment.



world war imminent, the Company was unable to embark on new explorations. And so the idea lay dormant during the long war years.

Then in the summer of 1948, officials of British Columbia came east and through their encouragement, Alcan sent out a survey party that same summer. As a result of their field investigations, the Kitimat Project was proved possible. By early 1951 the planning was complete and in April of that year the directors of Aluminium Limited, the holding company of which Alcan is the chief producing subsidiary, were able to give the go-ahead signal. Then commenced a great Canadian undertaking.

The Engineering Aspect of Kitimat

The Kitimat Project is really five separate engineering feats. First a dam was constructed to impound the waters of the chain of lakes. Second, the ten-mile tunnel was driven through the mountain barricade to give passage to the falling waters. Third, a powerhouse was carved inside a mountain to convert the energy of the rushing waters into electrical power. Fourth, was the erection of a transmission line to carry the power to the smelter. And finally came the building of the aluminum smelter at the end of a barren fiord. Each of these tasks was a major operation in itself. Their total had never before been attempted.

Ten-foot-thick concrete slab spread on the bed of the Nechako River to serve as a base for Kenney Dam.



A fleet of passenger and freight planes made their own roads through the waste land: planes lift men from their floundering through the bush and accomplish in weeks what formerly would have taken years.

Kenney Dam

The Kenney Dam, largest but not the highest rock-fill dam in the world, finished in December of 1952, is the starting point of the Kitimat Project.

Engineers spent months exploring and sounding several tentative sites for the Dam before settling on a location in the Grand Canyon of the Nechako River. Here the engineers could plug the eastern outlet of a 5,500 square mile drainage area and create a 358 square mile reservoir out of a dozen large lakes.

As was true of all the five phases of the integrated Kitimat Project, the Nechako

Canyon was remote. The first requirement was a road so that men and equipment could gain access to the Dam site. A two-lane, sixty-mile road was hacked through bush and muskeg in record time. Twelve weeks from the day the advance party stepped off the C.N.R. train at Vanderhoof, B.C., the new road rumbled with trucks and trailers hauling heavy equipment to the Canyon. This road remains as a tourist route for the future.

Armed with modern construction equipment and with over 1,000 men to operate it, the engineers began the attack on the River. Before a dam can be built the water-bed must be dried. Ordinarily, this is done by the device



Kenney Dam rising in the wilderness during the summer of 1952.



Closing the gates of the diversion tunnel, an historic moment in November 1952. The waters of the Nechako River were finally sealed off. Storage of water commenced.

A mountain taken apart and moved, truck *load by*





Kenney Dam in November 1952 just before the closing of the gates of the diversion tunnel.

Waters of the mountain lakes rising against the Kenney Dam. When the storage reservoir is full in early 1957, only the top 30 feet of the 317-foot high Dam will be above water.

*truck load by truck load, then put together again
scoop*





The blue waters of Tahtsa Lake covered with ice. On the shore is the construction camp of the hard rock miners who were driving a river through the mountain. Clearly seen are the ski tracks of the planes which served the snow-bound workmen and their families.

of wooden coffer dams but the Nechako Canyon was too deep and narrow for this coffer dam procedure. So the men cut a new channel for the River. Through one high bank, they bored a great tunnel in a sweeping arc. The thirty-two foot diameter tunnel commenced upstream above the Dam site and ran 1,539 feet parallel to the River, but inside the bank, and came out below the site of the Dam. In two months' time the diversion tunnel was ready. In August, 1951, the River was blocked with rock and earth just at the point where the diversion tunnel started. The water swirled into the tunnel and the main channel was dry.

Thus the men and their equipment were free to clear the bed of the River. The Canyon walls and the River bed were stripped to solid rock. A concrete slab 150 feet long, 82 feet wide and ten feet thick was spread on the dry bed where once the waters roared. All was ready to form the Dam. On May 20, 1952, the placement of rock began.

There are many types of dams. Some are made of concrete, some are called rock-fill dams. To block the Nechako River, the designers

decided upon a rock-fill type of dam. This means that rock was built up as a heap on top of the stripped River bed. Then impervious clay was placed on the upstream face of the Dam and covered with gravel. It took 1,000 men six months to fill the Dam with rock and clay. They took a nearby mountain apart, hauled the rock to the Canyon and there put the mountain together again. Every 45 seconds, during the summer of 1952, one of the fleet of trucks dumped its load of rock on the Dam, its driver directed by radio from a central dispatch tower.

Work continued on the Dam during the long summer days of 1952. In November, 1952 the task was nearly finished. The 114-ton gates of the diversion tunnel were slowly lowered and the storage of water began. Named after E. T. Kenney, former Minister of Lands and Forests in the British Columbia Government, Kenney Dam rises 317 feet above the old bed of the Nechako River and measures 1,550 feet from one side of the Canyon to the other. With a crest width of 40 feet, and containing over $6\frac{1}{2}$ million tons of rock and clay, its life will be measured in geological, not historical, time.

KITIMAT—A SAGA OF CANADA

The waters are rising against Kenney Dam and will continue to do so until 1957 when the 358 square mile reservoir will be full. Discharge of surplus or flood waters will be effected at a location part way up the reservoir and remote from Kenney Dam. At a place called Skins Lake a gated spillway has been constructed to discharge waters over Elevation 2,800 through the Cheslatta Lake Basin to re-enter the Nechako River five miles below Kenney Dam.

358 Square Mile Reservoir

At one time fears were expressed in some quarters that the scenic splendour of Tweedsmuir Park would be harmed by the reservoir. However, even though 873 billion cubic feet of water will be contained between the Kenney Dam and the tunnel inlet, only 3% of the watershed will be affected by the rising waters. Only part of this area is within the Park. When the finger-like lakes are linked together at the final reservoir height the total reservoir area will be 358 square miles, double the former lake area. Tweedsmuir Park covers 5,400 square miles.

Some low lying land, notably along the north shore of Ootsa Lake, will be submerged. The

topography of the land, however, is such that the water level of the lakes involved will merely rise higher against the rock and forest bowls in which they are set. And now for the first time, what has been a tourist and sportsman's paradise accessible only to the fortunate few, can be reached by the access roads built by Alcan to carry men and supplies into the district. In addition to the Vanderhoof-Kenney Dam road, a hundred miles were also slashed through the wilderness from Burns Lake, on the main C.N.R. line, to the east end of Tahtsa Lake. As the reservoir slowly fills, hidden lakes formerly separated by laborious portages will be linked. A wonderland, in a remote corner of the world, will be open.

The Power Tunnel

On December 2, 1953 two begrimed hard rock miners grinned at each other through a jagged opening blasted from solid rock deep inside Mount DuBose. A power tunnel had been cut through the barrier. For twenty months, hundreds of Canadian miners had worked the clock round. Their machines and

Barging through the frozen waters of the mountain chain of lakes. From rail at Burns Lake, B.C., new roads were slashed 100 miles westward. The final stage to the tunnel entrance in Mt. DuBose was travelled on self-propelled barges.





Drilling a river through a mountain. At the face of the tunnel, drillers stand on the jumbo. Using compressed air for power, they drive a 2" diameter drill 15 feet into the rock. A hundred such drill holes are loaded with explosives, the charge set off, the broken rock removed and fifteen more feet of tunnel is made.

skill had carved a 25-foot-diameter, 10-mile-long "river" through a mountain. When it was done, the tunnel looked easy but it is a spectacular accomplishment. Three times world records were broken, the last time in February, 1953, when 282 feet of tunnel were torn out in a single week.

The boring of the tunnel started on October 22, 1951 on the western shores of sky-blue Tahtsa Lake, followed soon on November 4, 1951 by crews headed eastward from sea-level Kemano River. Meanwhile, two other crews prepared to start tunnelling eastward and westward at a mid-point adit driven into the side of Mount DuBose at Horetzky Creek. Thus the tunnel job was attacked at four faces simultaneously; two crews working from the

middle outwards and two other crews, working from the east and west portals.

At the Tahtsa Lake or east end of the tunnel, the miners could work from the shore level. On the west side of the mountain, 10 miles away, the engineers were faced with a difficult problem. Their drilling had to start one-half mile up the steep face of the mountain. A road was out of the question so they built their road in the air! A giant aerial tramway was rigged up the cliff. A nine-ton car riding on 5,500 feet of thick steel cable carried 20 tons of machinery or 60 men at a time.

Inside the tunnel, a crew of 40 men worked at each face. Perched on four platforms on a movable scaffold nicknamed a "jumbo", they drilled up to a hundred blast holes, each fifteen feet deep in less than two hours. Then the jumbo would be pulled back and the drill-holes filled with explosives. After the blast, the shattered rock was loaded into cars and the waste hauled out of the tunnel to the dump. Then the cycle would be repeated. Drill, blast, load and haul out the debris. The job took twenty months and when the ten-mile tunnel was finished, the locked lakes had a new channel to sea-level. The waters could be put to service generating power.

Kemano Generating Station

Kemano is an Indian word meaning "Men of the Rocks". It is well named, for the glacial

The horseshoe-shaped tunnel, twenty-five feet in diameter, from Tahtsa Lake to Kemano River nears completion.





Breakthrough of the ten-mile-long Kemano Tunnel in the early morning hours of December 2, 1953. After twenty months of labour, men drilling eastward greet, deep inside the mountain, the men who had been drilling towards the west. And they met on dead centre.



Aerial view of towering Mt. DuBose. Inside this mountain is the ten-mile-long tunnel and the penstocks through which a torrent of water from the mountain lakes falls half a mile. At the base is the Kemano River and the construction camp. The clearing up the face of the mountain marks the route of the aerial tramway. At the tramway top is the 2,600-foot level, the portal entrance to the main tunnel.

waters of the Kemano River flow in a deep, narrow valley shrouded by mile-high granite peaks. No one ever lived in the Kemano Valley but the small bands of nomad Indians who roamed the area and occasionally broke the silences while hunting bear and mountain sheep. These "men of the rocks" gave their name to the River.

Now the granite mountain shelters the world's most powerful electrical generators, turning out 150,000 h.p. each to power Alcan's smelter at Kitimat. A place of silence now throbs in a new industrial age. The mountains look down on homes, schools and churches and hear the music of first run Hollywood movies.

The land starting point for Kemano was, as usual, a road. From a tidewater anchorage on Gardner Canal a ten-mile, two-lane gravel

highway was thrust up the shore of the Kemano River in the summer of 1951 and a construction camp built 200 feet above sea-level at the base of what was soon named Mount DuBose—after McNeely DuBose, Vice-President in charge of the Company's British Columbia Project.

Soon 14 other camps were housing as many as 5,000 men. They started excavation of the powerhouse cavern on September 21, 1951 and finished July 10, 1953. While it is unusual to build a powerhouse underground, it is by no means unique. Some 75 hydraulic underground powerhouses are operating in all climates. The deciding factor as to choice of an outdoor or indoor station rests on geological and economic conditions. Kemano went underground for many reasons including lack of suitable space

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in the constricted Kemano Valley; more economic foundations for massive machinery; freedom from landslides and savings in steel and concrete. As a plus value, the station is safe from enemy air action.

To breach the mountain and start construction at the powerhouse, a horseshoe-shaped access tunnel 27 feet wide and high was driven 1,346 feet to the location of the powerhouse. Two other bores parallel the main entrance. One is the tailrace, measuring 27 feet in diameter by 1,407 feet in length, through which the falling waters escape into the Kemano River; the other is smaller, 8 feet by 10 feet by 1,403 feet—first serving as an exploration drift to gain knowledge of the rock structure, then later converted to a permanent ventilating tunnel.

Miners excavated 570,000 tons of rock in clearing the powerhouse cave. A total of four million tons was removed in all the underground work of boring the tunnel, the penstocks, the powerhouse and entrance tunnels. To hold all this rock, a fleet of trucks each 15 feet long and carrying 15 tons would stretch bumper to bumper for 780 miles.

The first generator was on power at Kemano

on July 15, 1954, followed quickly by two more. These three generators having a capacity of 450,000 h.p. are sufficient—with spare capacity—to serve the first phase of 91,500 tons of aluminum production. However, the great cavern, 82 feet wide by 135 feet high by 700 feet in length has room for still five more generators. To bring Kemano to its ultimate 2,240,000 h.p. capacity—which is not scheduled at this writing—another 10-mile tunnel will be required; the powerhouse will have to be lengthened some 400 feet and, of course, additional generating equipment will need be installed. Certain other somewhat small constructions in the reservoir and at Kemano are in the plans.

The Kemano generators are driven by the largest multi-nozzle impulse turbines ever devised. These turbines are vertical, single-runner, 4-nozzle type designed for 150,000 h.p. at 327 revolutions per minute. They drive directly connected three phase, 60 cycle, 13,800 volt generators rated at 122,000 k.v.a. The power from each group of two generators feeds into a bank of three single-phase 89,000 k.v.a. transformers. A 300,000 volt, 4-inch diameter oil-filled power cable, with 60 pounds

Kemano Bay, fifty miles inland from the Pacific Ocean, is on the Gardner Canal. From the mountain-shadowed wharves, a two-lane gravel road was thrust ten miles up the valley to the site of the powerhouse.





Excavating over half a million tons of rock for the world's largest man-made cave. When completed the Kemano powerhouse, a quarter mile inside the mountain, will be vast enough to house a great ocean vessel such as the "Queen Elizabeth" or enfold a cathedral in its rocky embrace.

per square inch oil pressure carries the output of the transformer over 2,000 feet to the surface switch yard. From the switch yard the power takes its path along the 50-mile transmission line to Kitimat.

The Kildala Pass

From Kemano to Kitimat is tough country. The distance is only 50 miles but the land rises from sea-level at Kemano to mile high Kildala Pass and back to sea-level at Kitimat. A mile up and a mile down. And glaciers, crevasses and sharp rocky clefts and cliffs are all in between. The question was not so much how to build the transmission line; the real doubt was whether a line could be built at all.

Today the transmission line spanning Kildala Pass is a monument to Canadian engineering courage and skill, persistence and science. It was the most difficult and unique phase of the entire project.

Surveys and investigations of the route began in 1949. On the summit, 2,000 feet above the timber line, a test span was erected between two 26-foot-high aluminum towers. Automatic measuring instruments festooned the line as though it were a Christmas tree and made their record of gales from the Pacific Ocean and ice formed from snow and rime. To

supplement the machines, men were stationed in cabins along the transmission route and spent lonely days where snow lay 20 feet or more deep. In time the calculations showed that the transmission line must withstand winds of 80 miles per hour and ice loads five inches thick weighing 40 pounds per foot. These figures were in themselves a challenge, for no transmission line of such strength had ever been made. But a solution was found.

Back in the laboratories, scientists collated the data and made their calculation. Then they put together a test length of the largest overhead transmission cable ever made. Thick as a man's wrist, 2.295 inches in diameter and made of 108 strands of aluminum over 37 strands of steel; weighing only 4.77 pounds per foot yet having an ultimate strength of 135,700 pounds, this cable proved it could do the job.

While the cable problem was solved, the men seeking a path for the transmission line were falling behind. Mired in muskeg and hindered by snow fields, progress was slow. So they called on a new Thunderbird to flex its wings. Helicopters had done yeoman service for the military forces. Maybe the whirly-bird could "chart" Kemano Valley.

The use of the helicopters is a story in itself. One of Canada's most renowned airmen



The rotor of a 150,000 h.p. generator being lowered into position in Kemano powerhouse. Three generators are now in service. The ultimate installation will be sixteen great generators with a total capacity of 2,240,000 h.p.



Up and over mile-high Kildala Pass, power surges to Kitimat. The aluminum towers on the left and the steel towers on the right are firmly anchored to withstand gales or avalanches. Hidden in the clouds, except on occasional clear days, this aerial-view of the transmission line is mute evidence of man's ability to enter the wilderness and bend nature to his will.

Carl Agar, was summoned to Kemano to pioneer high altitude landings and take-offs,—about which the instruction book said nothing. In the thin air and treacherous down drafts, Agar's pilots found new hazards and learned new flying techniques to overcome them. The engineers and workmen soon had full confidence that Carl Agar and his pilots were the answer to "men in a hurry". Five Bell Model 47 helicopters and 2 Sikorsky S-55's based at Kemano were the largest fleet of such craft ever used for civilian purposes. From the arm-chair comfort of the helicopters, surveyors looked down on the uncharted labyrinth of crags and valleys between Kemano and Kitimat. In a few weeks, surveys were completed aloft that would have required months, maybe years, by men on the ground. The route of the transmission line was mapped.

Accurate surveys are one thing but towers and cable are not moved over a paper road on a

blueprint. After six snow-blown months, a road had been edged part way up the valley. It was the middle of May 1952. Mark Knight and Russ Madsen stared at the forbidding slopes ahead. These men of the contracting firm of Morrison-Knudsen had done the impossible to get from Camp 5 at the Powerhouse site to Camp 9, part way up Glacier Creek Canyon. Only six miles separated them from the top of Kildala Pass—but what a six-mile stretch! Rising rapidly, about a thousand feet to the mile, the road would have grades up to 25%. Miles of "switch-backs" must be blasted, despite snowslides and avalanches. These six miles would take a long time unless heavy equipment could be miraculously dropped on the summit. Then the road could be pushed from the bottom and from the roof.

Albert Charron, a plucky French-Canadian, and his helper Bill Henry volunteered to pilot an International TD-24 crawler tractor up a steep snowfield,—150 feet deep at the base. Stopping only to eat and sleep, Charron and Henry covered about a mile a day. In seven days they made the top, their tractor a black dot on the blinding snow to the anxious group watching from below. Though much remained to be done, Kildala had been conquered. The entire access route was ready by December 1952 and the construction of the transmission line commenced.

Again helicopters played a major role in saving time. Supplies and equipment were bundled on the ground, helicopters hovered over the load while sling hooks were attached and then sailed away to the erection crews the 'copters had spotted along the right-of-way. On four hour shifts, the 'copters never touched the ground. On favourable days, 75 round-trips were circled with the precision of a drilled racing team. The transmission towers began to dot the wild terrain.

The Kemano-Kitimat transmission line system is organized into three sections. The first section, a double circuit, 53 single steel tower line, extends from Kemano switchyard to a switching station 9 miles up the valley. There, motor-operated, selector, disconnect switches transfer the power flow to two single circuit lines for the 5,300-foot climb into the

Here is a road hung from steel cables! The way was too difficult for a highway up Mt. DuBose. Yet equipment was needed half a mile above the Kemano Valley floor to drive the tunnel. So the engineers built a road in the air, a giant aerial tramway large enough to carry 60 men at a trip.



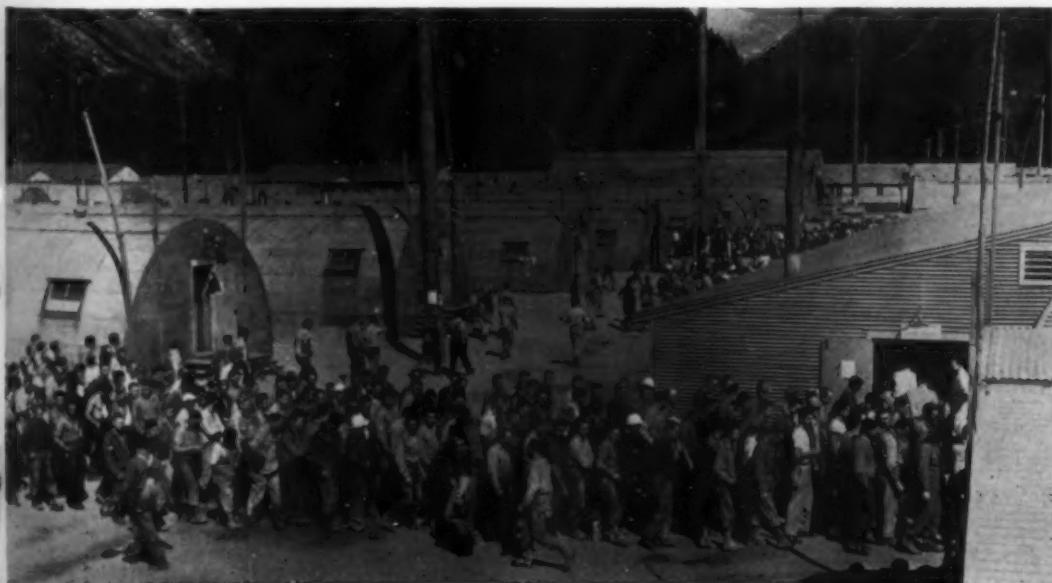
clouds over Kildala Pass. One circuit is carried on 39 steel towers, the other on 39 aluminum towers. This 10.6-mile-long section reaches another switching station when the power returns to one double circuit which runs the remaining 30 miles to Kitimat over a 178 steel, single tower line. On July 15, 1954 a switch was closed. Power surged to Kitimat. Three and one-half years of labour by tens of thousands of men employing \$275 millions of capital were the prelude to this day.

Kitimat—a Dream in the Wilderness

It was a cold, gray day in April 1951 when six carpenters stepped from a small boat to a lonely shore. Deep snow covered the tidal flats and beyond towered the forests. From this humble beginning, history would be written. This time to stay.

These six carpenters were not the first white men to come to Kitimat. Over fifty years ago, around 1900, Kitimat had a land boom! The Canadian National Railways had rail as far as Edmonton, Alberta. Their eyes were on Kitimat for their western terminal. Speculators ran up land prices and then the Kitimat bubble burst. The C.N.R. decided on Prince Rupert as the end of steel on the Pacific Northwest. The eagles and the bears were alone again. Later some settlers homesteaded in the area but despite the fertile soil, the lack of markets and communications made them give up the futile struggle.

Why did Alcan choose Kitimat? To the casual observer, 80-mile-long Douglas Channel ends on mud flats without promise. However, the eye of the engineer looks below the surface. As he observes his mind is transforming the

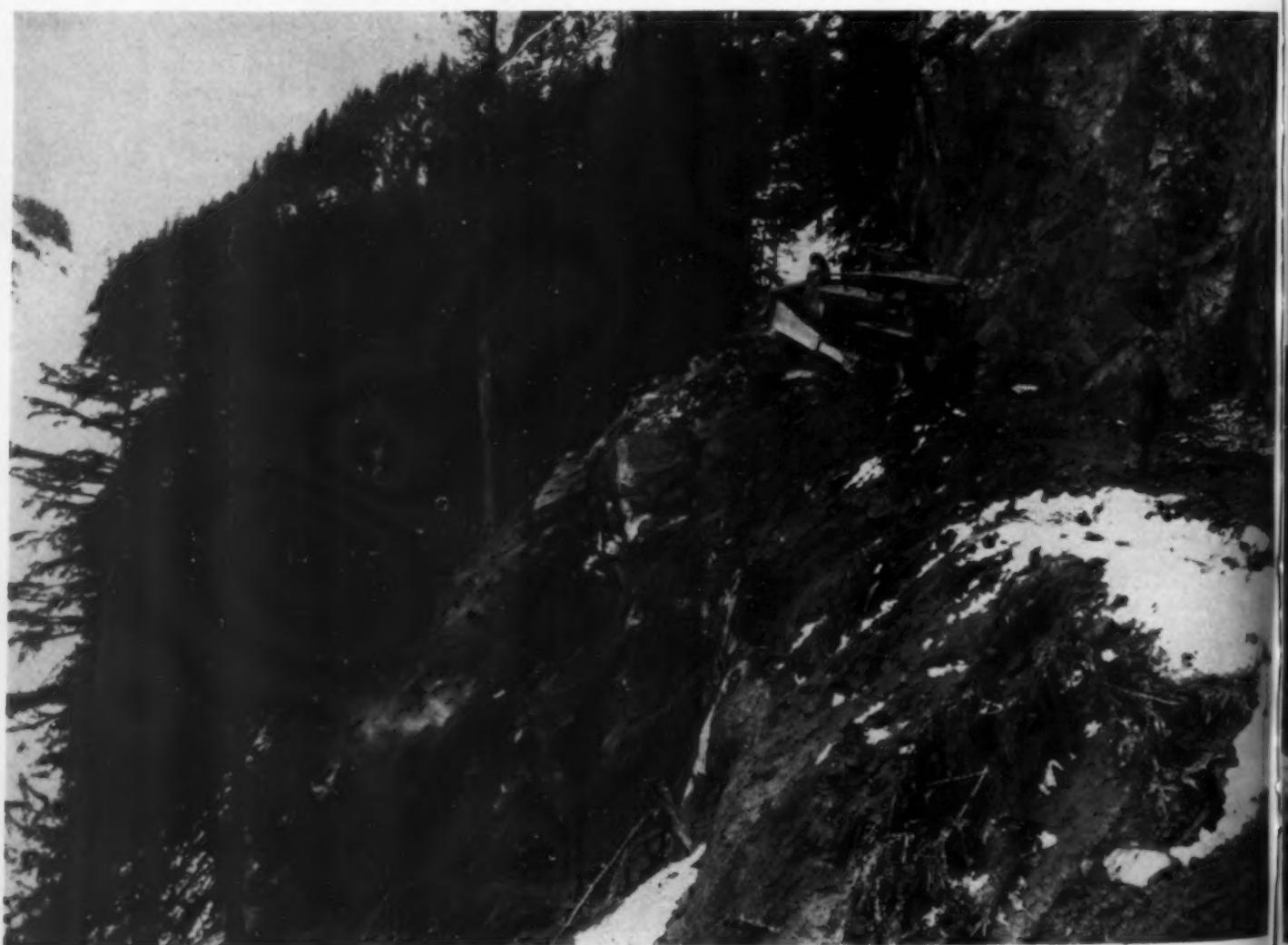


The workmen of Kemano lived well in their city in the valley. They came from every part of Canada and some from lands overseas. The "meal call" was the most popular call of the day. To a thousand men at a sitting, the chefs served pie for breakfast and steak for lunch.



Two Sikorsky helicopters, each capable of riding six men in its comfortable cabin or slinging half a ton of freight under its belly, were the work horses of the job. Where roads could not be built, the 'copters carved their own road with their wings.

While mountain sheep watched from their perch on a cliff, TD-24 crawler tractors butted a road up and over Kildala Pass. In the days of pick and shovel, the job would have been long and maybe impossible. With modern equipment the work is easier and the nearly impossible only tougher than usual.



High linemen stringing the aluminum cable, steel reinforced, on the 300,000-volt transmission line between Kemanano and Kitimat.

scene. In the words of McNeely DuBose "when looking for a townsite fairly close to the powerhouse, the Kitimat Valley proved to be the only large open area between Powell River and Prince Rupert which would invite a town of the size envisaged". Kemanano River Valley was too small, while five-mile-wide Kitimat Valley reaches 40 miles to the flourishing community of Terrace.

Then too, aluminum loves tidewater! Engineer DuBose saw beyond the desolation. His imagination created a vision of a harbour, homes where rose the wooded slopes and a smelter where the tides washed. And so the carpenters were his advance scouts of a coming army of construction workers. Their job was to build bunkhouses for more men who would build a wharf.

Then came the tractors, trucks, steam shovels and the myriad of earthmoving machines and other construction equipment. The summer of 1951 saw Kitimat's smelter and townsite under way.

Of interest is the word Kitimat. It comes from the Indian words "Kit-a-maat" (the Tsimshian name for the tribe of the neighbourhood) and is generally interpreted as Kit (meaning people) and a-maat (meaning falling snow) or "The People of the Falling Snow." The present name Kitimat, although the Indians still use the Kitamaat spelling, was adopted years ago following an exploration voyage by the Hudson's Bay Company vessel *Beaver*.



Maybe because there was no river to divert or a mountain to tunnel or a cliff to climb, 3½ years of toil went almost unnoticed in the building of Kitimat harbour and smelter. However, it was a spectacular venture.

Here are the construction statistics:

First construction personnel landed	April 1951
Man-hours worked to July 1, 1954	9,785,000
Acres of land cleared	650
Cubic yards of fill hauled by truck	3,500,000
Cubic yards of fill placed hydraulically	2,250,000
Cubic yards of material dredged for harbour	2,350,000
Miles of road built	16
Cubic yards of concrete mixed and placed	90,000
Tons structural steel erected	11,000

Black bears found their forest homes rudely disturbed.





Looking south, down Douglas Channel. In the left centre, the first phase of the Kitimat smelter nestles at tide-water, between the Kitimat River and the snow-capped mountains. When completed, the smelter will stretch 2½ miles along the valley. On the high ground in the left foreground, the first houses are showing in the clearing. Since the picture was taken, many more homes have been built. Some day the planned city of Kitimat will have ten thousand homes where none stood before.

Board feet of timber used.....	15,000,000
Board feet of timber cut by mill on site.....	12,575,000
Tons of freight handled, temporary wharf...	135,000
Square feet of aluminum sheathing placed..	1,750,000
First power applied to plant.....	July 15, 1954
Annual aluminum production capacity, first stage.....	91,500 tons

Eight major British Columbian companies pooled their resources and united to form Kitimat Constructors Limited. In the team were Dawson Wade & Co. Ltd., Marwell Construction Co. Ltd.; Campbell-Bennett Ltd.; Bennett and White Construction Company; General Construction Co. Ltd.; B. C. Bridge and Dredging Co. Ltd.; Dawson & Hall Ltd., and Emil Anderson Construction Co. Ltd.

These experienced Canadian associates were charged with the job of clearing and filling the smelter site area, preparing the townsite for services and homes and erecting the smelter.

The preparation of the smelter site was the

"time-taker". The 70-acre area, on the west side of the Kitimat area was a low delta of mud and fallen trees. To gain a firm foundation for the massive buildings to be erected there, the soggy soil was removed then replaced with clean strong fill.

Some of the gravel required came from the bottom of the harbour where dredging was necessary for the ship channel. The Kitimat Constructors' dredge pumped 12,000 cubic yards of fill a day—equal to the size of 30 bungalows—until at the end 2½ million cubic yards had flowed through the 24-inch pipeline.

Additional fill was needed and fortunately a mountain of gravel was found about four miles away. Just as at Kenney Dam, the mountain was moved truck by truck. Over 200,000 truck loads of fill moved from the gravel mountain to the smelter site four miles away!

At 3:00 p.m. on August 3, 1954, a distinguished group watched workmen pour the first aluminum at Kitimat. The ingot, removed from the mould, is seen on the table in the right foreground. The smiling group, reading from the left, are A. W. Whitaker, Jr., Vice-President and General Manager of Alcan; H.R.H. The Duke of Edinburgh; R. E. Powell, President of Alcan; The Right Honourable C. D. Howe, Minister of Trade and Commerce; McNeely Dubose, Vice-President of Alcan; Rear-Admiral J. C. Hibbard and N. V. Davis, President of Aluminium Limited.

Meanwhile tugs were making the four-day run from Vancouver, towing barges loaded with aluminum siding, steel girders, cement and the host of materials for the smelter itself. Slowly and surely the smelter area took shape.

On August 3, 1954, Kitimat was ready. The first phase of the smelter involves 12 acres of industrial buildings. Dominating the scene are the two potlines, where the raw material from Jamaica is reduced to aluminum. At 3:00 p.m. on August 3, 1954, the first metal was poured in the presence of a notable gathering. H.R.H. The Duke of Edinburgh "tapped" the first 50 pound ingot. Smiling at his side was President R. E. Powell of Alcan watching his dream come true. Thousands of engineers and tens of thousands of men spent years in building the Kitimat Development, yet if one man can be singled out, it was the leadership, patience and determination of Mr. R. E. Powell that brought Kitimat forth in the wilderness.

The first phase of Kitimat will produce 180,000,000 pounds of metal per year. Kitimat Project, however, is so designed that its power and smelter facilities can be extended to an output of 1 billion pounds of aluminum ingot per year. As said by Mr. Nathanael V. Davis, President of Aluminium Limited: "If the long term forecast materializes, as we expect it will, the Company, having laid the basis for rapid and lowcost expansion in British Columbia, should be in a position to meet the growing market."

The Kitimat Project is a saga of Canada. Won from the wilderness, Kitimat will grow with Canada. Its power from Kemano will surely, in time, make more aluminum and draw other industries. The forests, long ravaged by winter storms, are the nucleus for more and more services to each one of us. All who built Kitimat, the manufacturers, the engineers, the workmen and Alcan did so with the high purpose of a better way of life for today and all the tomorrows awaiting North Americans.

Power house construction men smile as the Duke of Edinburgh pauses for a friendly chat.



An honorary guard of Wolf Cubs stand on Kitimat wharf as the Duke of Edinburgh and Mr. R. E. Powell come ashore.



Contributors

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F. H. Wooding (*Canada's Atlantic Salmon*) is Director of Information and Educational Service in the Department of Fisheries of Canada. He has made a wide study of all phases of fisheries development and conservation and has written a number of articles on the subject.—Les Powell (*Goodwill Through Golf*), who is on the staff of Canadair Limited, is general manager of the International Golf Association and had much to do with arranging the Canada Cup matches in Montreal this year.—Paul Clark (*Kitimat—A Saga of Canada*) is an aluminum veteran. In the course of his long service with the Aluminium Limited group of Companies, he has been active in many divisions of the organization, and is well acquainted with the Canadian as well as the world-wide aspects of the industry.



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THE TRAVEL CORNER

News from Europe

Our European representative, Squadron Leader W. H. Corkill, M.B.E., recently made a trip around the Pas-de-Calais in northwestern France and into Belgium on his motor-cycle. He is very enthusiastic about the Silver City Air Ferry, which transported himself and the machine from Lympne, an airfield near Dover, to Calais. He writes:

"I reported with my motor-bike to Silver City at 2.45 p.m. They took charge of it, checked my travel papers, shepherded me through Immigration and Customs and tucked me into a plane. At 3.15 we took off, landing at Calais at 3.26. About twelve minutes later, having passed through French Immigration and Customs, I was riding along the Calais road to Dunkirk. The trip back was equally speedy. Return fare for myself and machine amounted to only \$20.15 in Canadian funds. To save time and avoid irritation, I'll certainly take the Air Ferry every time."

He found the roads in France and Belgium in good condition for cycling. Even the cobblestone paving in villages and towns proved negotiable. On a jaunt of this kind one takes one's chances about the weather. Our man had the bad luck to run into torrential rains and winds of gale-force through which he rode for four days on his two-stroke motorcycle. He says:

"I managed to keep dry but the effort of bucking gales—indeed of keeping on the machine—has left me a little exhausted. With the wind behind, I sailed from La Bassée at 58 m.p.h., which for a two-stroke machine is just impossible normally; returning, with the wind ahead, it was almost impossible to maintain 28 m.p.h. with the engine flat out." We were glad to learn that at least the first four days of the tour were attended by pleasant weather and that his enthusiasm survived the arduous latter portion of it undampened. He sums up his discoveries as follows:

"I found excellent accommodation and food exquisitely cooked at Hôtel du Vieux Beffroi, La Grand-Place, Béthune, and at Hôtel de la Croix d'Or, 19 rue Saint-Christophe, Soissons. Prices were very reasonable at

both places. (Both are in the Pas-de-Calais district of France.) I can also recommend Richmond House, 40 rue de la Concorde, Brussels. Excellent rooms and meals and convenient location.

"Undergrads touring France by cycle or motor-bike should eat and sleep at places displaying the sign 'ROutiers'. This really means 'Transport Drivers'. Believe me, they live well and at quite low prices compared with hotels. But I don't recommend all of these for girls."

He concludes that, despite storms on the road and wobbly knees upon returning to Lympne, the trip was worthwhile because he saw things which are missed on formal tours and had experiences which do not befall those of us who are whisked about by bus, train or plane.

(Continued on page VII)

the Vinoy Park HOTEL

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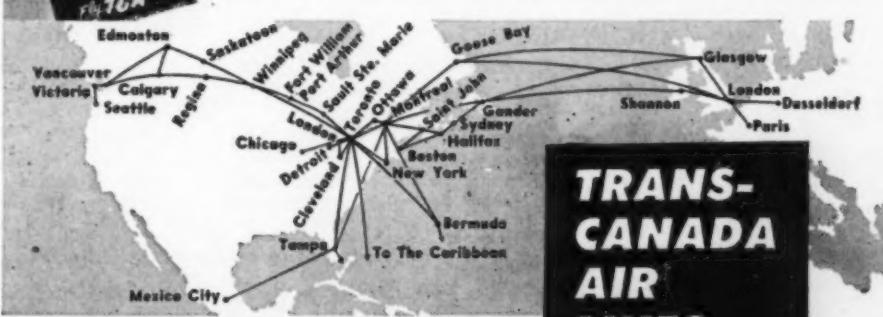
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FLYING OVER 19,000 MILES OF WORLD AIR ROUTES

(Continued from page VI)

The "Saxonia", a new 22,000-ton liner, has begun to carry passengers between Liverpool and Montreal. She was built for the Cunard Steamship Company by Messrs. John Brown and Company in their Clydebank shipyard, the same one in which the ship's predecessor, the first "Saxonia", was built nearly half a century ago. The new vessel carries 125 passengers in first class and 800 in tourist class. Her single funnel was designed specially to disperse smoke and exhaust gases clear of the ship so that people on deck would suffer no discomfort. Those prone to *mal de mer* will welcome the tidings that a pair of Denny-Brown stabilisers have been installed in the "Saxonia" to prevent rolling. Symbols of Canada have been used in decorating the lounges and other public rooms. On their walls are panels and murals depicting scenes from Canadian history. First class fare, one way, on the "Saxonia" from late fall till spring costs \$265 and tourist class \$165 and up. Fares are slightly higher during the summer.

* * *

Between April and October visitors to Ireland will be able to purchase package tours on the motor coaches of the C.I.E. (Coras Iompair Eireann), Ireland's Transport Company.

One may leave Dublin with no worries whatsoever about hotel reservations, meals or gratuities (all included in the basic rate) and spend six, nine, ten or twelve days traversing the delightful Irish countryside. The coaches stop at many places of interest to the visitor. Along the way you spend the nights at first class hotels. The coaches are comfortable and of modern design. They have adjustable seats, wide windows and the usual "sightseeing" roofs of glass or plastic. On the six-day tour one has the choice of visiting either southern or western Ireland. The nine-day tour includes both south and west, while the ten-day one also takes in Donegal. For the newcomer the tour lasting twelve days is recommended, since it covers the whole of Ireland. Travel commences between nine and ten o'clock in the morning and ends at 6 p.m. Rates are as follows: six days \$46.70 or \$52.54; nine days \$81.73; ten days \$93.41; twelve days \$110.92. Reservations may be made through travel agents or Irish Railways, 69 Yonge Street, Toronto.

* * *

The Italian Line's "Cristoforo Colombo", a luxurious new ocean liner, has entered service between New York and Mediterranean ports.

The 29,100-ton vessel is a sister-ship of the "Andrea Doria" with which many North American travellers are familiar. It makes alternate voyages with the "Andrea Doria" on this route. The trip from New York to Gibraltar, the first European port of call, takes five and one-half days. From Gibraltar the ship goes on to Naples, Cannes and Genoa.

The "Cristoforo Colombo" has accommodation for 225 passengers in first class, 320 in cabin class and 708 in tourist class. There are outdoor swimming pools for all three classes. Some of Italy's most competent architects and interior decorators were engaged to design the quarters for passengers. Their work has been embellished by oil paintings, statues and bas-relief panels. The total effect is one of elegance. First class fare, one way, costs \$335, cabin class \$260 and tourist class \$205.

* * *

Persons intending to visit Naples might be interested in lectures on the excavations of Pompeii which are given on request in Italian, English, French or German. They may be heard by groups of not less than twenty people. Arrangements are made by writing to Ente Provinciale

(Continued on page IX)

THE LAND OF INDUSTRIAL OPPORTUNITY

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ANOTHER CANADIAN PACIFIC "FIRST" IN CANADA



(Continued from page VII)

per il Turismo in Naples, stating the time the lecture is wanted, the language in which it is to be given and the particular aspect of Pompeian civilization to be discussed.

* * *

FROM THE CARIBBEAN

An agreement recently concluded between K.L.M. Royal Dutch Airlines and Saguenay Terminals (steamship subsidiary of the Aluminum Company of Canada) provides that passengers to the Caribbean area be granted 10% reductions on fares, if they fly one way and travel by ship the other. You may take a cruise of two to four weeks' duration on a vessel operated by Saguenay Terminals, then transfer at Port of Spain, Trinidad, or Curacao, Netherlands West Indies, to a K.L.M. plane for the return flight to Montreal. Or you may fly down from Montreal to Port of Spain and sail back to Halifax or Montreal.

* * *

Two ports of call have been added to the itinerary of Canadian Pacific's "Empress of Scotland" on its cruises to the West Indies and South America this season. They are Port-au-Prince, Haiti, and Barbados. On January 20 and March 4, 1955, the ship sails from New York to cruise for twenty days. She leaves on February 11 for a 19-day cruise. On all three voyages she will call at San Juan, Puerto Rico; St. Thomas, Virgin Islands; La Guaira, Venezuela; Curacao, Netherlands West Indies; Cristobal, Panama Canal Zone; and Havana, Cuba. However, on the longer cruises the Empress also will visit Port-au-Prince and Kingston, Jamaica. Barbados and Port of Spain, Trinidad, are extra stops on the shorter run. The minimum fare for the 20-day cruises is \$495, while that for the 19-day one is \$475.

* * *

DOMESTIC NOTES

As this column went to press the "William Carson", a new ocean ferry constructed by Canadian Vickers Limited for Canadian National Railways, was expected to enter service between Port aux Basques, Newfoundland, and North Sydney, Nova Scotia. One of the largest and most modern ocean ferries of its type in the world, the "William Carson" will carry motor vehicles as well as passengers and freight. The ship is a powerful twin-screw icebreaker, equipped with a bow propellor, and will be able to operate under even the worst ice conditions in Cabot Strait.

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AMONGST THE NEW BOOKS

A Thousand Geese

by Peter Scott and James Fisher
(Collins, Toronto, \$4.00)

Though geese have long been among the best-known birds of the British Isles as of Canada, the nesting grounds of some species have, till recently, remained undiscovered. It was not till 1929 that J. Dewey Soper found the main breeding ground of the Blue Goose on the Foxe Peninsula of Baffin Island, and it was in 1951 that Peter Scott and James Fisher ran down the principal breeding colony of the Pink-footed Goose in an oasis in the central desert of Iceland.

Their account of the expedition is of great interest, not only to ornithologists, but also to topographers and glaciologists, presenting as it does an excellent account of the physiography of that part of the world and definite evidence of glacial recession there. Archaeologists, too, will be pleased by the discovery of ancient stone goose folds, many of them apparently unused for centuries.

The scientific results achieved were concrete and valuable. Eleven hundred and fifty one geese were banded, far more than the expedition members had dared hope for, and hundreds of these have already been recaptured, principally in the British Isles. Of more importance still, perhaps, was the development of a technique for rounding up large flocks of goslings and moulting geese, alike unable to fly, and herding them into corrals of netting, and the sudden delighted realization that this was the same method, almost certainly, that the Icelanders had used to drive geese when the old stone goose folds were still in use. So successful were the techniques they evolved that a subsequent expedition in 1953 was able to band nearly eight times as many birds.

Other large breeding grounds of the Pink-footed Goose are, we learn, in Greenland and Spitsbergen. The Icelandic colony is estimated at about 13,000 birds, that of Spitsbergen perhaps less than a thousand

and Greenland less than two thousand. It is interesting to note that the only girl on the expedition, Philippa Talbot-Ponsonby, was banded too, becoming Mrs. Peter Scott just before they left Iceland.

The illustrations are good and there is a fine bibliography and index. The Icelandic place-names are a bit disconcerting, especially as one is instructed more or less how to pronounce them and feels obliged to try, but the book is excellently well written, and conveys a clear and lasting impression of the wild and desolate beauty of that remote and seldom visited desert country.

DOUGLAS LEECHMAN

* * *

Water

by Thomson King
(Macmillan, Toronto \$4.00)

This book is a valuable contribution concerning one of the commonest phenomena in our world. We take water so much for granted that we seldom think how inextricably the destiny of mankind depends upon its right use and control. Mr. Thomson

(Continued on page XII)



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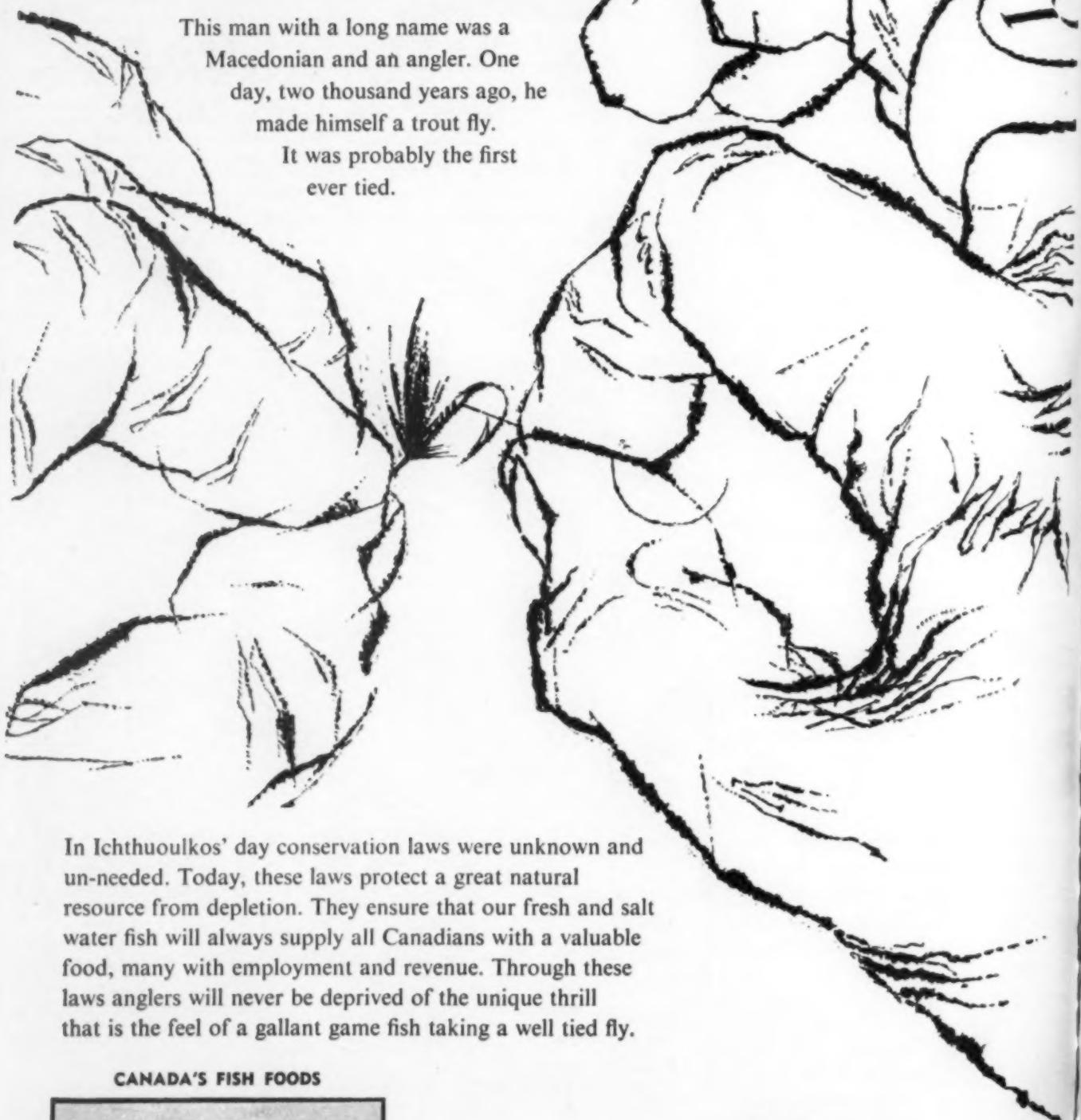
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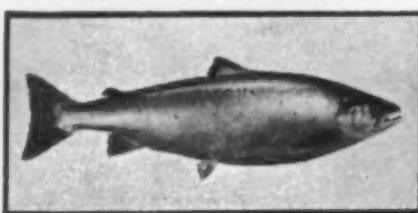
Ichthuoulkos

This man with a long name was a Macedonian and an angler. One day, two thousand years ago, he made himself a trout fly. It was probably the first ever tied.



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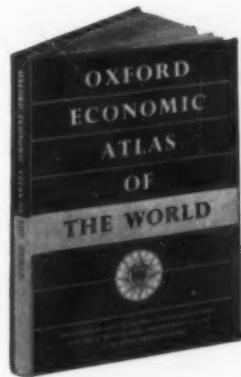
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(Continued from page X)

deals first with what he calls water's distinguished parentage, oxygen and hydrogen, and touches lightly on the chemical aspects. He then turns to animal life and draws a most interesting comparison of environmental conditions between life on land and life in the water. Next he traces the slow and often painful stages by which mankind learnt of water's mysterious powers and properties throughout the centuries, from the dim ages when water was merely a necessity to drink, or something on which to float a raft or ship. Herodotus records that the ancient kings of Persia discovered the necessity of boiling their drinking water when they were campaigning in distant lands, some twenty centuries before Leeuwenhoek first beheld disease germs in a drop of water through his home-made microscope. The problem of providing pure drinking water for large cities has been tackled by succeeding generations in a variety of ways.

To compel the seas and rivers to be the servants and not the destructive masters of mankind was a hard task. The Egyptians needed a waterway from the Nile into the Red Sea; the first canal was dug about 1380 B.C., and another was started about seven hundred years later which cost the lives of 120,000 workers. Though the Romans understood the art of building canals they could not control the water levels. Perhaps it was the Dutch, who knew only too well how terrible an enemy water could be to their land, who first invented the use of locks; or it may have been the Italians, for by 1487 the genius of Leonardo da Vinci had provided the city of Milan with six locks. Thereafter followed the drainage of swamps, the irrigation of deserts, the invention of the pump, the development of water power and the contribution of steam power to our civilization today. Finally the author reminds us that the oceans, rivers, glaciers, rain and snow, dew and vapour will continue to carve and shape the earth's surface, irrespective of man's habitation on this globe.

S. SEELEY



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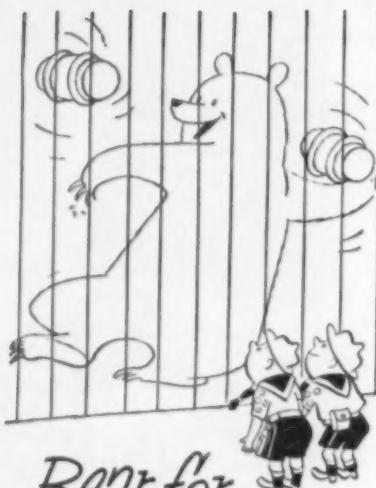
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Bear for Punishment

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Geographische Grundlagen der Geschichte

by Hugo Hassinger

(Herder and Co., Freiburg, 1953,
11, 391 pp., 10 maps)

This is the second edition, slightly revised and enlarged, of a geographical introduction to a world history appearing in several volumes.

The central idea of the book recalls L. Febvre's *La Terre et l'évolution humaine*, which also is a geographical introduction to world history. However Hassinger uses a different approach to Febvre and describes the

spatial limits and the environment of the areas that have been the centre of civilizations. These various forms of civilization evolved and developed in the midst of lands and peoples which have become the great nations of today. When he describes these nations, he explains not only the physical, but also the cultural environment, and how this cultural environment has been formed.

The first three chapters of the book are devoted to the influence of geographic factors on the course of history, on the development of civilization and the localization of its main centres, and on the structural and ethnic features of the continents.

In the succeeding four chapters, the great centres of cultures are described according to their nature, evolution and function: the old world (Egypt, Mesopotamia, Arabia, Iran and the Middle East); the monsoon lands (India and China); the Mediterranean countries; Europe; the great oceans; the New World (America); and Australia and New Zealand.

The final chapter is a review of the great empires of the past and present, their evolution from clans to empires and from small principalities to the vast continental and maritime associations and federations of today.

This study is a remarkable synthesis of the geographic influences on world history. It is illustrated by several original maps, and supported by an exhaustive bibliography of 63 pages.

P. CAMU

* * *

Westward Ho with the 'Albatross'

by Hans Pettersson

(Macmillan, Toronto, \$4.00)

This is a well-written account of a Swedish Deep-sea Expedition which circumnavigated the world in a 1,400 ton motor schooner between July 1947 and October 1948. The chief purpose of the expedition was to collect samples of sediments from the bottom of the deepest ocean abysses. So that the stratification of these sediments, of great importance to geologists, might not be disturbed, they were collected in the form of cores, using a specially devised sampler which yielded cores as much as forty and fifty feet long and provided

a wealth of new and most significant information.

In style, the book is a model for those who would prepare a popular account of a scientific expedition. The inviting preface, the clear statement of the methods and purposes of the voyage, the lucid explanation of the importance of the work and the inter-dependence of the many sciences involved, all contribute to an easy understanding and a feeling of sharing in the enterprise.

The serious accounts of work at sea are pleasantly varied by stories of visits to remote islands where rare plants and other unusual specimens were collected and the crew made the acquaintance of many interesting people.

It is with genuine regret, if not alarm, that one learns that this work is to be discontinued and all the special gear built for use on the *Albatross* laid aside. The money that would be needed for further work, it is hinted, is required for munitions of war and the cost of national defence.

DOUGLAS LEECHMAN



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